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Off-Line Field Test Design for Evaluating Two Approaches to Person-Job Matching: The Army Recruit Quota System (REQUEST) and the Enlisted Personnel Allocation System (EPAS)

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14. ABSTRACT *(Maximum 200 words)*:

The Enlisted Personnel Allocation System (EPAS), initially developed through a multi-year research and development project conducted by the U.S. Army Research Institute for the Behavioral and Social Sciences(ARI), is the latest tool available to the Army for improving the classification process. Designed to be a subsystem of the Recruit Quota System (REQUEST), EPAS is a person-job-matching (PJM) method that optimizes the assignment of recruits to entry-level military occupational specialty (MOS) training. It goes beyond REQUEST, the Army's present approach to PJM. REQUEST identifies high priority MOS for which an applicant meets the minimum Aptitude Area composite score qualifications. In addition, EPAS identifies those MOS in which an individual is likely to perform with the greatest effectiveness, while meeting overall Army accession goals and filling critical MOS.

A PC-EPAS prototype was created and evaluated based on laboratory simulations of the Army's classification process in FY 1998. The results of laboratory classification simulations provided evidence that EPAS can improve the mean predicted performance (measured as the average Aptitude Area composite score of recruits in their assigned job training) of a fiscal year recruit cohort, while simultaneously meeting Army enlistment requirements. Based on these positive laboratory results, ARI developed a production version of EPAS in FY 2000. The planned field test will examine the likelihood of realizing the laboratory findings in an "operational" environment, using EPAS linked as a subsystem to REQUEST and to actual transactions data within a simulation framework. This report describes the planned field test design.

15. SUBJECT TERMS

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FOREWORD

Classification is the process of assigning new enlisted personnel to initial job training in the Army. Investigations of improved methods for doing this have been a prominent part of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) research program since shortly after World War II. The immediate antecedent of this work was the ARI Project B research, conducted over the 1982 – 1989 period, which led to the testing of a mainframe prototype. PC prototype development began in the fall of 1993 and was largely completed by the spring of 1997, at which time the Deputy Chief of Staff for Personnel (DCSPER) recommended that ARI continue the work and move toward implementation. Army management reviewed the Functional Description (FD) in the Fall of 1998, and the Director of Military Personnel Management (DMPM) recommended that ARI conduct a field test evaluation. The evaluation is scheduled for the 2001 – 2003 period.

The Army currently takes a minimum enlistment standards approach to classification. EPAS, working as a subsystem of REQUEST (the Army's training reservation system), is an attempt to go beyond minimum standards and make better use of each recruit's potential. Laboratory simulation testing of the prototype models indicated the likelihood of sizeable gains in classification efficiency, and the objective of the field test is to confirm these gains in the presence of real-world constraints and decision-making. This report describes the design for the field test evaluation.

The focus of the Selection and Assignment Research Unit of ARI is conducting research, studies, and analysis on the measurement of aptitudes and performance of individuals, in order to improve Army selection, classification, retention, and promotion of officers and enlisted Soldiers. This study will provide the foundation for recommended improved aptitude measurement and classification procedures for enlisted personnel.

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Off-Line Field Test Design for Evaluating Two Approaches to Person-Job Matching: The Army Recruit Quota System (REQUEST) and the Enlisted Personnel Allocation System (EPAS)

EXECUTIVE SUMMARY

Background:

Classification is the matching of recruits into their entry job training. The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) has been conducting research and studies into better classification methods and developing the Enlisted Personnel Allocation System (EPAS), with the aim of enhancing the Army's current training reservation system, known as REQUEST. EPAS is designed to enhance REQUEST by introducing optimization methods into what is a sequential assignment process. This is done by treating the assignment process as two phases. In the first phase, a linear programming model represents the (forecasted) monthly flow of applicants and availability of training class seats over the recruiting year. Applicants are categorized into supply groups by their demographics and aptitude profiles. The optimal allocation or matching of (applicant) supply groups to military occupational specialty (MOS) training classes is determined. The optimal allocation is the one that maximizes predicted performance for an annual accession cohort, while meeting accession and training management goals. The model solution is updated weekly and used to generate an ordered list of MOS training recommendations that best match each supply group with training requirements. In the second phase, that of actual applicant assignment, these recommendations are merged with those generated by existing REQUEST procedures and presented to the applicant by the career counselor.

Research Requirement:

A large-scale ARI research effort called Project B explored alternative approaches to the Army classification issue, and led to the development in late 1980's of a mainframe-based EPAS prototype. This work was continued in the mid – 1990's with the development and laboratory testing of a PC-based EPAS prototype. Following the recommendations of Army management in 1998, ARI is conducting a field test evaluation of the EPAS subsystem over the 2001 – 2003 period. The objective of the "field test" is to examine the efficacy of EPAS with as much operational realism as possible while having no effect whatsoever upon USAREC business transactions.

Findings:

To accomplish the objective, ARI has designed a non-intrusive field test using operational transactions data (between potential recruit and career counselor) within a simulation framework. The REQUEST system provided the EPAS project with transaction data -- all the training opportunities presented to each applicant – over the FY 2002 period. In the "fixed list" design alternative, the EPAS recommendations are merged with the actual training opportunities, and the applicant's choice from the merged list is made (simulated) using a statistical job choice model. Each simulation is comprised of thirty replications. The fixed design constrains the potential benefits that could be realized by EPAS, and so a "dynamic list" design is also

of the original REQUEST list; this facilitates a more accurate portrayal of the cumulative effects of EPAS over the fiscal year.

Results of the simulations will be employed to address the following major operational issues:

(1) Classification efficiency of EPAS-enhanced REQUEST (EER). The metric of merit is the mean predicted performance (MPP) of recruits based on their (Aptitude Area Composite scores corresponding to the) MOS assignments under REQUEST and EER classification systems. The analysis is designed to compare the overall classification benefits of EER and REQUEST, and to examine whether classification efficiency is disproportionately biased towards certain MOS to the disadvantage of other MOS.

(2) Impact of EPAS upon the training opportunities presented to applicants (i.e., job list analysis). The analysis is designed to address: How large is the intersection between the REQUEST and the EPAS list? How is the size of the intersection affected by the date of training? What is the frequency of priority MOS at the "top" of the EER list?

(3) Impact of EPAS upon meeting overall and priority accession requirements. The analysis is designed to address: How does EER compare to REQUEST in meeting overall Army monthly accession goals? How does EER compare to REQUEST in meeting accession goals for priority MOS?

Within each of these areas, this design document specifies indexes with which to measure the impacts. The key role and specification of the job choice model is also fully described.

Utilization of Findings:

As its name implies, the field test evaluation design described in this report provides the conceptual and theoretical underpinnings for the simulation approach, analysis, and evaluation of the field test.

OFF-LINE FIELD TEST DESIGN FOR EVALUATING TWO APPROACHES TO PERSON-JOB MATCHING: THE ARMY RECRUIT QUOTA SYSTEM (REQUEST) AND THE ENLISTED PERSONNEL ALLOCATION SYSTEM (EPAS)

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I. INTRODUCTION

The Enlisted Personnel Allocation System (EPAS), initially developed through a multi-year research and development project conducted by the Army Research Institute for the Behavioral and Social Sciences (ARI), is the latest tool available to the Army for improving the classification process.[1] Designed to be a subsystem of the Recruit Quota System (REQUEST), EPAS is a person-job-matching (PJM) method that optimizes the assignment of recruits to entry-level military occupational specialty (MOS) training. It goes beyond REQUEST, the Army's present approach to PJM (see Figure 1). REQUEST identifies high priority MOS for which an applicant meets the minimum Aptitude Area (AA) composite score qualifications. (Applicant composite scores are derived from military entrance testing known as the Armed Services Vocational Aptitude Battery – ASVAB.) In addition, EPAS identifies those MOS in which an individual is likely to perform with the greatest effectiveness, while meeting overall Army accession goals and filling critical MOS.

A PC-EPAS prototype was created and evaluated based on laboratory simulations of the Army's classification process in FY 1998. The results of laboratory classification using the EPAS Optimal Guidance (EOG) list provided evidence that EPAS can improve the mean predicted performance (measured as the average AA composite score of recruits in their assigned job training) of a fiscal year recruit cohort, while simultaneously meeting Army enlistment requirements. Based on these positive laboratory results, ARI developed a production version of EPAS in FY 2000. The planned field test will examine the likelihood of realizing the laboratory findings in an "operational" environment, using EPAS linked as a subsystem to REQUEST within a simulation framework. This report describes the planned field test design.

Background

EPAS Optimal Guidance

EPAS produces a separate list of MOS training assignments for each of 127 recruit Supply Groups, which are groups of recruits based on demographic characteristics and ASVAB subtest score profiles. The list that EPAS outputs is called the EOG or EPAS Optimal Guidance, and is also referred elsewhere in this document as the EPAS list. The MOS job training opportunities in this list are ranked from high to low in terms of an EPAS Index of System Efficiency. This index reflects the estimated Aptitude Area Composite score of the recruit Supply Group for each MOS, and the forecast of contracts and MOS training requirements over the planning horizon. Since EPAS would be updated daily or weekly, the guidance weights current Army enlistment needs most heavily. However, it also accounts for the "big picture," which includes the results of assignments already made and the forecasts of contracts and MOS training requirements for the current and following fiscal year.

EPAS-enhanced REQUEST List

[1] This section draws on M.A. Lightfoot and P. Ramsberger (2000), *Matching Recruits to Jobs: The Enlisted Personnel Allocation System* (Special Report 41). Alexandria, VA: Army Research Institute for the Behavioral and Social Sciences.

The present notion for integrating EPAS as a subsystem of REQUEST is to run the EPAS PJM process along side the PJM process of REQUEST as shown in Figure 2. The EPAS Optimal Guidance assignment list for a selected Recruit Supply Group would be merged with the REQUEST assignment list for a particular recruit who fits that Supply Group profile. The EPAS Optimal Guidance would be used to reorder the REQUEST assignments from highest to lowest

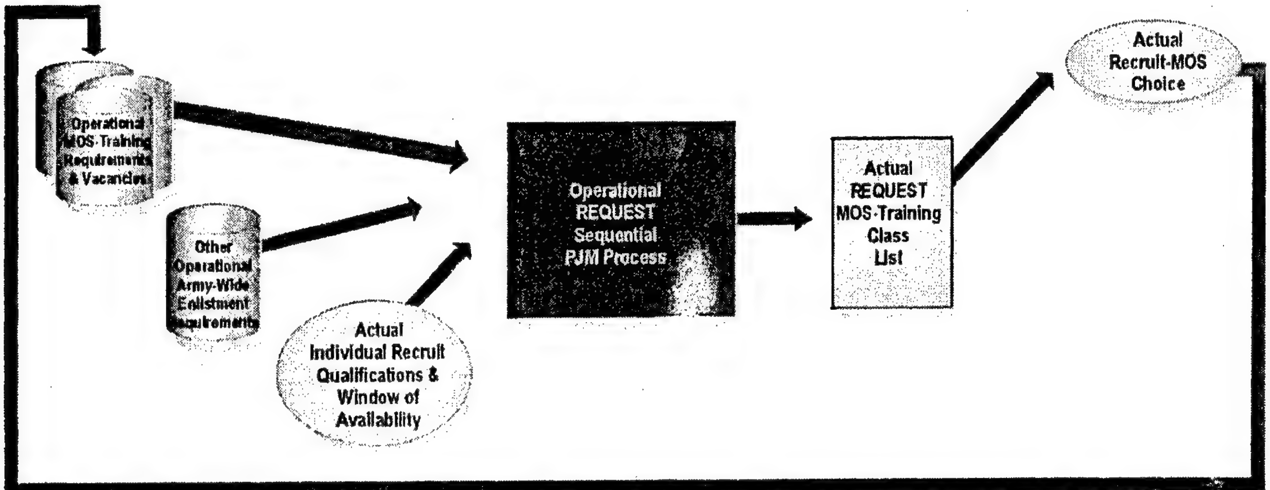

Figure 1. Graphical Depiction of the Operational REQUEST Classification System

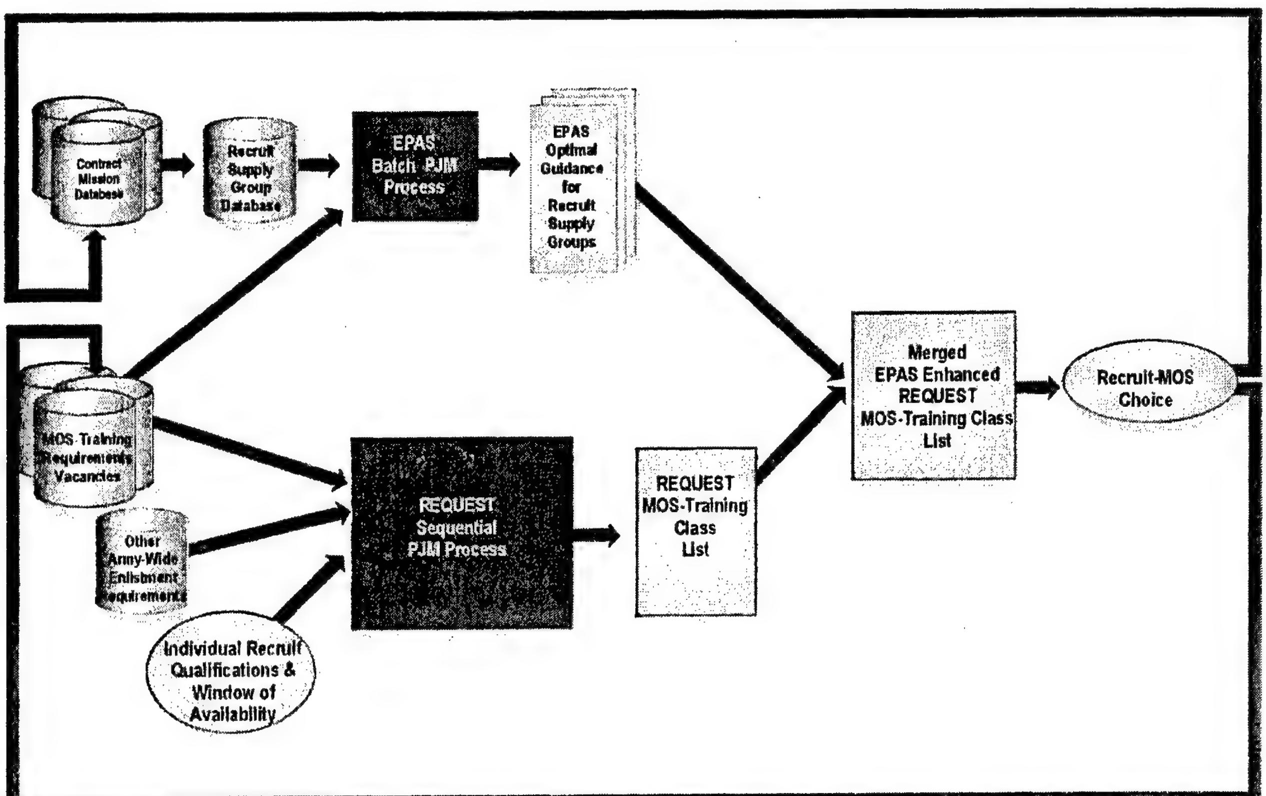

Figure 2. Graphical Depiction of the Proposed Operational EPAS-enhanced REQUEST Classification System

in terms of an EPAS Index of System Efficiency. This approach would capitalize upon the EPAS near-optimal batch processing technique based on Army contract missions and MOS training requirements.

What will help ensure the greatest possible overlap between EPAS Optimal Guidance and REQUEST assignment lists is that the EPAS optimization algorithm also takes into account Army-wide enlistment requirements, such as meeting critical and hard-to-fill MOS needs and balancing the distribution of highly qualified recruits across all MOS. Where there are discrepancies between the two lists of assignments, the non-overlapping EPAS assignments would be dropped, while the non-overlapping REQUEST assignments would be retained and placed at the bottom of the list in the order in which they were output by REQUEST. This will help to ensure that critical enlistment requirements are given high priority in the integrated REQUEST-EPAS classification system. The final integrated REQUEST-EPAS merged list is also referred to in the remainder of this document as the EPAS-enhanced REQUEST list.

The integrated REQUEST-EPAS classification procedure has potential benefits for both the Army and the Soldier. The Army will gain through the higher potential for training and job success of all recruits. Soldiers will gain because better matching of their aptitudes to MOS requirements creates a higher potential for career success. When a recruit cohort is taken as a whole, the hybrid REQUEST-EPAS assignment process is expected to produce high quality assignments, which raise the average Aptitude Area composite score across all MOS and simultaneously meet critical Army enlistment requirements.

The field test will be conducted within a non-intrusive simulation framework that will maintain a high degree of operational realism. The integrated REQUEST-EPAS procedure, referred to elsewhere in this document as the EPAS-enhanced REQUEST (EER) system, is the ultimate focus of this field test. Its classification efficiency and capability to meet Army enlistment requirements will be compared to the current REQUEST system in an operational environment. The field test will also compare the MOS training opportunities in the EPAS list with those in the REQUEST list, in order to examine how EPAS impacts recruit training opportunities in an operational environment.

The organization of the remainder of this document is as follows. In Chapter 2, the issues described above are more specifically formulated in the form of field test research questions. Chapter 3 discusses the main components of and key issues in the proposed off-line field test approach. Chapter 4 provides a technical description of the indices that will be employed in analyzing the research questions, and presents an overview of the approach in these analyses.

II. FIELD TEST STUDY QUESTIONS

In this chapter we present the underlying study questions that are central to the three sets of analyses in this field test. We discuss how each of these three analyses is important to the Army and briefly describe the respective indices associated with the questions identified. The detailed technical descriptions of the indices are provided in Chapter 4.

Job List Analysis

The job list analysis is important to the Army for two reasons. First, the job list formulated for a recruit by the REQUEST and EER classification systems will affect the range of MOS training class choices that the Army may offer this recruit. This will have a direct effect on a recruit finding a job that is acceptable and, consequently, his or her likelihood of enlisting in the Army. Second, the composition of the EPAS-enhanced MOS list will have practical implications for the guidance counselor's flexibility in selling jobs to a recruit. This is important as the MOS training class not only must appeal to the recruit, but must be consistent with Army priorities. The questions proposed below guide our approach to evaluating the impact of the EPAS enhancement upon MOS training choices of recruits.

- *How large is the intersection between REQUEST and EPAS list?*

The intersection will be measured in terms of the count or proportion of common MOS-class-month choices between the REQUEST and EPAS lists of individual recruits. Two approaches will be employed to construct the index for this analysis. The first approach will be based on the simple count of matching MOS training opportunities in the REQUEST list and the EPAS optimal guidance list of recruits. The second approach will take into account the respective locations of matching MOS training opportunities in the REQUEST list and EPAS list of recruits. The index computed in the second approach will represent the "quality" of the intersection between the two lists. Using either approach, a large intersection between REQUEST and EPAS list will lead to greater potential EPAS benefits. As an extreme example, if the intersection between the two lists is zero then EPAS will have no effect on the MOS job classifications of recruits, as the EER list is simply the original REQUEST list itself.

- *How is the size of the intersection affected by the date of training class?*

In this question, we are interested in finding out whether the MOS contained in REQUEST and EPAS lists match but class start dates do not. The indices that will be employed to analyze this question will be based on the count and proportion of choices in the REQUEST list whose MOS appear in the EPAS list for the recruit. REQUEST class dates and EPAS class months will be ignored when matching the MOS in the respective lists. In this analysis, intersections that are substantially larger in comparison to those obtained in the analysis of the preceding research question would indicate that EPAS is missing potential optimization due to mismatching training dates. Results from this analysis will have implications for relating the EPAS model optimization to REQUEST DEP controls.

• *What is the frequency of priority MOS at the "top" of the EPAS-enhanced REQUEST list?*

The analysis for this study question will examine to what extent potential EPAS optimization may be achieved in a way that is consistent with Army recruiting interests. For each recruit, the count and proportion of priority MOS at the top-*n* of the EER list will be compared to the corresponding count and proportion of priority MOS at the top-*n* of REQUEST list. The length *n* will be determined from a preliminary analysis of REQUEST and EER lists. For this analysis, "consistent" will be indicated by the occurrence of priority MOS at the top of the EPAS-enhanced list.

Classification Efficiency Analysis

The EPAS optimization model is in part based on matching recruit ASVAB profiles to the aptitude requirements of individual MOS. For a given recruit, the optimization guidance suggested by the EPAS list would tend to put the recruit in the job where he or she is expected to best perform based on the ASVAB profile. This EPAS enhancement of REQUEST is anticipated to yield classification gains in the overall Army accession cohort. This hypothesis will be examined in the following questions.

• *How does EPAS-enhanced REQUEST compare to REQUEST in terms of overall classification benefits?*

In this question we are interested in comparing the overall expected performance of the Army accession cohort under the current REQUEST and EER systems of classifying recruits to MOS. The index in this analysis is recruit mean predicted performance (MPP). For a specified evaluation period, recruits will be assigned to MOS using classification simulation procedures that will be conducted separately for each classification system. Recruit predicted performance will be calculated and averaged separately under each system based on their assigned MOS. Comparison of the MPP calculated under the two classification strategies will indicate whether or not EPAS enhancement significantly adds to the classification efficiency of REQUEST.

• *Is classification efficiency disproportionately biased towards certain MOS to the disadvantage of other MOS?*

The analysis in the preceding study question pertains to overall Army classification gains. In this question, we are concerned with the equitable distribution of potential classification gains across MOS that is anticipated from the operation of EPAS-enhanced REQUEST. To answer this question, the MPPs under the two classification systems will be calculated and compared separately by MOS. The intra-MOS classification efficiency differences between the classification systems will be examined, and MOS that exhibit disproportionate classification gains will be noted. This analysis is not concerned with the disparity in the MPP across MOS, which is related to the respective quality requirements of MOS.

Accession Requirement Analysis

Issues that are addressed in the following study questions pertain to the overriding goal in Army recruiting policy. In the end, anticipated EPAS classification benefits will have to be achieved while at the same time meeting Army recruit accession requirements. The underlying issue in the two questions listed below is whether or not the person-job matching optimization process of the EPAS enhancement adversely affects the Army's ability to meet accession goals.

- *How does EPAS-enhanced REQUEST compare to REQUEST in meeting overall Army monthly accession goals?*

The analysis for this question will compare how well monthly overall Army accession goals are met under the REQUEST and EER classification strategies. The index in this analysis will be the percentages of Army accessions relative to the monthly target accessions, calculated separately under the REQUEST and EPAS-enhanced REQUEST classification systems. This analysis is important to the Army, as monthly accession goals are critical building blocks in meeting fiscal year recruiting goals. In scheduling training class dates and seat availability throughout a given fiscal year, Army recruiting policy makers take into account seasonal patterns of recruit quantity and quality. To the extent possible, weekly and monthly training seats are not to be left unfilled, otherwise they become lost training opportunities with associated costs.

- *How does EPAS-enhanced REQUEST compare to REQUEST in meeting accession goals for priority MOS?*

This question focuses on MOS that are most critical to the Army in carrying out its mission. Analyses related to this question will examine the monthly and total fiscal year accessions of each priority MOS under REQUEST and EPAS-enhanced REQUEST classification conditions. For a specified priority MOS, the analysis index would be the percentage of total accessions relative to the goal for the MOS. Priority MOS that will be considered in this analysis will be identified with the help of Army recruiting policy makers.

III. OFF-LINE FIELD TEST SIMULATION METHOD

A key requirement of this study is to develop a method of evaluating the potential benefits of EPAS-enhanced REQUEST that will not affect the actual operational selection and job assignments of Army recruits. The field test design described in this report compares the current REQUEST MOS assignment and training reservation system to an EER system using 12 months of actual data with an off-line simulation method. The data encompass Army recruit supply and MOS and training demand data, the REQUEST list of MOS vacancies and associated training classes generated specifically for each recruit, and the particular MOS assignment decisions made by the recruits with assistance from Army guidance counselors.

In this chapter we describe the off-line evaluation strategy, which is based on a simulation of a 12-month Army classification process designed to retain key realistic components of the Army recruit classification process. The off-line nature of the field test means that the study will not interfere with actual Army assignments during the evaluation period. It does place limitations on inferences about the realism of the findings, but the design minimizes these limitations.

The purpose of the field test is to evaluate whether the person-job matching procedures of EPAS, when combined with REQUEST classification processes and subjected to real world constraints (e.g., MOS priorities and short DEP periods), will improve recruit-MOS matching (measured in terms of a job performance index) and meet critical MOS and accession requirements. It is the simulation of the effects of EPAS that is the main rationale for the off-line aspect of the field test. The simulation is designed to retain the main features of the Army recruit classification process subject to the off-line evaluation constraint.

Our discussion of the off-line field test method begins with a description of the four components that will be included in the simulation of REQUEST and EPAS-enhanced REQUEST. We will then specify the three evaluation periods that can be included in the study. This will be followed by a description of the classification simulation itself, including the strengths and weaknesses. The next section will present in detail two alternative methods of generating REQUEST MOS training lists for the simulations. This process is critical for obtaining valid, realistic simulation results. The methods will have different impacts on the results, so their strengths and weakness will be discussed. Finally, we will describe the MOS assignment decision-making model that will be the tool for generating off-line MOS training class assignments. Without this decision modeling technique the off-line field test would not produce operationally credible results.

Main Components of Army Classification System Included in Field Test

The operational Army recruit classification system can be divided into four main components that are, jointly and separately, relevant to investigating the research questions in this field test. The first and second components, respectively, are the supply of Army contracts and the demand to fill MOS and training classes. These two components together define the Army recruit classification environment. The third and fourth components, respectively, are the process of managing the availability of MOS and training class opportunities for individual

recruits through the REQUEST system, and the decision-making process involved in assigning recruits to MOS, which is conducted by Army counselors at Military Entrance Processing Stations (MEPS). Generally, the Army uses the REQUEST system, managed by the U.S. Total Army Personnel Command (PERSCOM) in conjunction with operators and analysts at the U.S. Army Recruiting Command (USAREC) and Army counselors at the MEPS, to manage the flow of recruit supply and to ensure that MOS and training seat demand are met. Guidance counselors work with a recruit's ASVAB test scores and career interests to identify a person-job match that balances Army accession requirements with recruit personal goals.

The proposed off-line classification simulation method is a combination of actual and simulated versions of the preceding four components. The first two system components, which form the Army recruit classification environment, will be the missioned supply of recruit contracts and actual demand for filling Army jobs, represented in terms of MOS and quality distribution quotas covering the evaluation period. The third and fourth system components, which are constrained by the requirement to conduct an off-line field test that does not impact Army recruiting, accession management, and classification, will be represented in the off-line simulation by empirically derived procedures described in this report.

Supply: Army Recruit Cohort Data

Evaluation of the potential benefits of an EER system over REQUEST will be based on actual Army recruit cohort data. Recruit data will pertain to determining recruit qualifications for different MOS. This will include recruit ASVAB test scores, demographics, and physical and other attributes that are used for screening purposes in some MOS.

Data from the REQUEST transaction between a recruit and guidance counselor at the MEPS will also be recorded. The two most important of these are the REQUEST MOS class list (a.k.a. training opportunities list, which includes information on enlistment bonuses, educational benefits and other relevant incentives related to the MOS choices available to the recruit) that is rank-ordered by start date, and the recruit's actual MOS and training class choice.[2] Retaining the connection between recruits and their MEPS transaction dates in the assignment simulation will allow us to capture the seasonality of recruit quantity and quality inflow throughout the evaluation period.

MEPS location and selected counselor attributes (e.g. gender, length of service, and number of years as counselor) may also be recorded. These additional data form part of the overall recruit cohort characteristics, and could be included in the simulated classification of recruits if they help explain the pattern of recruit MOS training choices observed in the data.

Demand: MOS Vacancies and Training Seat Opportunities

The demand side of recruit-MOS assignments will be represented by the schedule of MOS training seats that is created and updated by PERSCOM Accession Management Branch (PERSCOM/AMB). This schedule describes the seat availability for specific MOS by weekly

[2] The Army's Keystone Office, manager of the REQUEST system, provided FY 2002 data to the EPAS field test project as customized Keyview extracts that were retrieved on a weekly basis.

class start date, training location, and gender distribution. The training seat totals and allocation among MOS are determined from overall Army and MOS level FY accession goals. Specified monthly accession targets are used to monitor and direct filling of the overall Army and MOS level requirements. This helps to keep accessions on track to meet fiscal year goals. Demand is also characterized by recruit quality distribution defined in terms of AFQT (Armed Forces Qualification Test) and education categories at the overall Army level. This is transferred to variable MOS level quality distribution goals, depending on the training and job requirements in each MOS.

The number of MOS vacancies and open training seats in the field test will be updated as recruits are assigned off-line to MOS training class start dates throughout the evaluation period. As in the real world, unfilled class seats will be considered lost as assignments move past the class start-date. Beyond this simple class-fill update procedure, there are systematic and subjective factors that ultimately determine the periodic availability of training classes to individual recruits. The way these factors will be handled in the simulation procedure is related to the way the REQUEST list will be generated, and is discussed below in the section entitled "Methods of Generating REQUEST MOS Training Class Lists".

REQUEST and EPAS-Enhanced REQUEST MOS Training Class List

As described above a guidance counselor works with a recruit to select an MOS and training class with a start date that corresponds to the recruit's availability. The basis of this recruit classification transaction is an MOS training class list. REQUEST generates the list of up to 35 MOS class start date combinations for the counselor to review with the recruit.[3] All MOS on the list are those for which the recruit has a passing Aptitude Area (AA) score. The REQUEST system ranks the MOS according to the Army's needs to fill job and training seat vacancies during a particular month. EPAS enhancements to REQUEST are designed to affect the ranking of MOS training classes.

In contrast to REQUEST, EPAS orders MOS from highest to lowest AA score as long as they are above the cut off score. EPAS takes into consideration some, but not all, of the training class start date information that REQUEST does. EPAS-enhanced REQUEST merges the EPAS list (called the EPAS Optimal Guidance) with the REQUEST list. Several merge algorithms are under consideration. The most likely possibility will be that MOS appearing on both lists will be retained in the order determined by EPAS. The non-overlapping MOS on the REQUEST list will be placed at the bottom in the order prepared by REQUEST. The non-overlapping MOS in the EPAS list will be dropped from the merged list.

Recruit MOS Training Class Choice

The final component of the field test is a statistical decision-making model of recruit MOS training class assignments, which we are developing from the database using econometric techniques. Model development depends greatly on fitting a sample of about three months of data to alternative methods. The MOS assignment decision-making model will play the part of

[3] If the recruit does not see a job he or she is interested in, or has a specific job in mind, then REQUEST also can generate a list of class dates for a specific MOS.

the actual transaction between a recruit and guidance counselor at the MEPS, which determines the recruit's MOS and training class choice. It is the key component that permits the design of an off-line evaluation strategy, allowing us to meaningfully recreate recruit MOS training class choices. The model will be represented by an equation, from which the odds of the recruit selecting each training choice in a given list will be derived.

During the off-line classification of recruits to jobs, assignment probabilities corresponding to the alternative MOS training choices in the REQUEST or EER list of a recruit will be calculated. These probabilities will be a function of recruit ASVAB profile and demographics, the associated MOS and rank order training choices in the REQUEST list, along with other transaction variables that will be considered, such as enlistment bonus and term of enlistment. The probabilities, in turn, will determine the odds of a recruit "selecting" a particular training choice on the list. This choice involves a randomization process that allows the possibility of assigning the "same" recruit to different training classes in different assignment replications. (Refer to the description of the simulation process below.) The relative frequency distribution of recruit and MOS training choice attributes across many replications would be expected to follow the choice pattern in the actual REQUEST transaction data from which the recruit choice model is derived.

The motivation for the recruit choice model approach is discussed in the section entitled MOS Assignment Decision-Making Model. A technical overview is in Appendix A, including an illustration of an MOS training choice randomization process.

Evaluation Periods

We propose to analyze the field test results using 6- and 12-month data. We can also conduct monthly analyses. Since EPAS is a fiscal year classification optimization model, the 12-month data should conform to a fiscal year (FY) and cover a full FY recruit cohort.[4]

Preliminary monthly assessments of REQUEST and EPAS-enhanced REQUEST could be carried out in the first six months of the field test. The main advantage of one or more preliminary analyses is that they would provide initial estimates of the anticipated classification gains of EPAS-enhanced REQUEST. These estimates, however, would not reflect any cumulative classification effects and would underestimate EPAS benefits.[5] Intermediate analyses will be carried out using a six-month evaluation period. These results are expected to provide better estimates of EPAS enhancements than the preliminary analyses, but the relatively short evaluation period will not allow EPAS to fully capitalize on its cumulative optimization procedure.

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[4] Twelve months of data, with data collection starting in the middle of a fiscal year, could be used. However, any changes in the recruit cohort, recruiting environment or Army priorities effective at the beginning of the FY may add noise in the database that could present some level of difficulty in analyzing the results. Further, presenting field test findings that partially cover two fiscal years to Army decision-makers could add unnecessary complications to an already complex discussion.

[5] Note that the EPAS person-job matching algorithm successively accumulates classification gains monthly throughout the FY by optimizing the assignment of current contractees to current and future MOS-class-months through the use of monthly supply and demand projections.

The final set of analyses will most likely be carried out for the full fiscal year evaluation period. The REQUEST MOS training list can be either the operational list or a simulated version that will make the REQUEST and EER conditions comparable. This is discussed in the section entitled "Methods of Generating REQUEST MOS Training Class Lists". If the REQUEST MOS training list is simulated off-line under the same conditions as the EPAS list for both the REQUEST and EER conditions, then the results will reflect the unique fill rate patterns of each system, and allow EPAS to build upon its optimization without constraint. We expect the 12-month analyses, especially if the REQUEST list is simulated, to provide more accurate information on EPAS-related cumulative classification benefits than the intermediate analysis.

Below we describe a single replicate of the off-line classification simulation process conducted for a non-specific evaluation period and simulation condition.

Off-line Classification System Simulation Process

The four components needed to conduct the off-line field test, which are described above, will be integrated in a simulation, with replication, of the Army's recruit classification system. Replicated simulations of the Army recruit-MOS classification process will be carried out separately under REQUEST and EER conditions and will generate the data with which the research questions will be answered. The simulations under the two conditions will differ in the assignment opportunities included in the MOS training lists that are "presented" to recruits, since the differences in the lists mark the primary research conditions. The list for EPAS-enhanced REQUEST will be generated partly off-line. A decision about whether to generate the REQUEST list off-line in both systems to maintain comparability of the conditions must be made before the simulation programs are developed. As we mentioned above, this issue is discussed in detail in Methods of Generating REQUEST MOS Training Class Lists.

Figures 1 and 2 in the Introduction present graphical representations of operational REQUEST and proposed EPAS-enhanced REQUEST, without including the modifications necessary for the off-line simulations. Modified figures are presented later in conjunction with more detailed descriptions of the simulations. A single replication in the simulations will correspond to a complete classification of all recruit contracts in the evaluation period under consideration. Starting from the earliest contract in the evaluation period, recruits will be classified into jobs following the order of actual recruit inflow to ensure a realistic distribution of recruit attributes by contract date.

At the start of each replication the training class seats will be set equal to their actual, respective fills at the beginning of the evaluation period as recorded in the auxiliary REQUEST data collected for the field test. A list of MOS training opportunities will be constructed for the recruit. This list will be either a REQUEST or EER list, depending on the classification system condition.[6] Given the MOS training opportunities in the list, the recruit will be assigned

[6] The REQUEST list used independently in REQUEST itself, or merged with the EOG in EPAS-enhanced REQUEST, may be generated on- or off-line according to the evaluation period, if a decision is made to simulate the REQUEST MOS training list. Otherwise the REQUEST list will be generated on-line. The EOG will always be generated off-line.

stochastically to a MOS training class seat using the recruit MOS assignment decision-making model outlined above.

MOS vacancies and class seat fills will be updated after classifying each recruit during the evaluation period. These updated class fills will be used as input in generating the REQUEST list of MOS training opportunities for subsequent recruits, and will depend on the classification system condition (REQUEST or EPAS-enhanced REQUEST) and the REQUEST MOS list generation method described below. For the EER simulation, the updated class fills at the start of each week also will be provided as input to the EPAS optimization routine. After classifying the last recruit in each replication, the training class seats again will be reset to their actual REQUEST fills at the beginning of the evaluation period before starting the next replication using the same data. A single classification simulation replication will be completed after the recruit with the last contract date in the evaluation period under consideration is classified. Repeating the above replication thirty times will generate the complete set of simulation data for a given condition and evaluation period.

Analysis indices for the three sets of research questions will be computed for each classification system replication under REQUEST and EER conditions in an evaluation period. For analysis related to the job list comparison research questions, indices for comparing MOS training opportunities under the two conditions will be calculated at the individual recruit level. Classification efficiency and accession requirements indices will be calculated based on the off-line MOS "assignments" of recruits for the entire cohort in the evaluation period. Note that even though the classification simulations in the two conditions are separate, the order of recruit contract date and demand for MOS training class seats during the evaluation period are fixed. Fixing supply and demand will help provide the basis for establishing true differences between REQUEST and EPAS-enhanced REQUEST, if they exist.

We conclude the description of the off-line simulation process by taking note of the seemingly awkward scenario of an individual recruit probably "choosing" different MOS or training classes in different replications. The key to understanding the analytical intent of the simulation design is to disassociate a recruit's actual identity from his or her recruit attributes. The following two assumptions underlie the off-line classification simulation strategy in this field test. The first is that the seasonal distribution of Army recruit attributes by MOS contract date in the operational REQUEST data to be used in the field test represents the pattern typically observed across fiscal years. The second assumption is that recruit attribute by MOS training opportunity patterns are to some degree revealed in the field test data. In light of these two assumptions, the averages of different indices across replications in the analysis should be interpreted as statistical measures of specified characteristics of a classification system having approximately the same recruit supply and Army demand environments as represented by the seasonal distribution of recruit attributes and MOS training opportunities in the operational data.

Strengths and Weaknesses of the Off-line Simulation Method of the Field Test

The primary practical strengths of the off-line simulation method (proposed to compare the performance of EPAS-enhanced REQUEST to that of REQUEST) are its ability to evaluate EPAS enhancements without interfering in the operations of REQUEST, impacting the

attainment of Army accession missions, disrupting the MEPS recruit counseling process or reducing present levels of recruit training and job performance. In addition to the practical benefits there are four scientific advantages to conducting an off-line field test.

First, the off-line simulation method allows us to use data from a full FY recruit cohort in all field test conditions instead of using data sampling techniques. On-line sampling of REQUEST and EPAS-enhanced REQUEST would require temporal and probably geographic sampling that would introduce error variance, which may be difficult to detect even with the use of control variables.

Second, assuming that it would be operationally feasible to randomly assign recruits to either REQUEST or EER conditions in an on-line field test, it would be difficult, if not impossible, to independently measure the Army-wide effects of the two conditions. This is because of the different dynamic feedback process in the classification systems, in which assignments of recruits to training classes at a given time impact assignments at a later time through the availability of class seats. The use of sampling approaches for running REQUEST and EPAS-enhanced REQUEST on-line during a FY would confound the separate effects of each system on MOS and training class fill rates. Further, developing an error term for the indices associated with each set of research questions would be difficult and the error probably would be quite large. If an operationally and scientifically acceptable procedure were developed, it would be complex and expensive to implement. We believe the off-line simulation, based on fixed Army supply and demand data in both conditions is an effective strategy for controlling time-related fill rates.

Third, replicated analysis provides an estimate of the error variances of the evaluation indices. This is needed for building confidence bounds, which are necessary for proper comparison of results from the two classification system conditions.

Fourth, by using off-line simulations, alternative elements of the Army classification system not currently in use may be considered in the field test without undermining current recruiting goals or assignments. For example, different classification composites and job families could be examined. The length of the Delayed Entry Program (DEP) could be manipulated to study potential benefits related to EPAS-enhanced REQUEST or REQUEST. (Note that EPAS is designed to use DEP length to create efficiencies). These types of analyses, especially the DEP analysis, could be highly valuable to Army policymakers for classification strategy and planning purposes.

On the other side of the equation are the weaknesses of the off-line simulation method of the proposed field test. First, field test results from a simulation study, which cannot include all operational factors, may be considered less credible than operational field tests by policymakers and managers. This is not necessarily true as implied by the discussion of strengths above. On a more general level, a well-designed simulation study may produce more accurate findings because of the greater control of irrelevant error variance.

A second weakness is that off-line simulation methods are challenging and time consuming, especially when they involve complex systems such as REQUEST and EPAS. In

particular, results will only be valid to the extent that analytical techniques that replace subjective operational procedures are meaningful and reliable. An example of such an analytical technique is the recruit MOS assignment decision-making model that will play the part of the recruit and counselor assignment transaction at the MEPS. This model is a stochastic representation of the assignments based on recruit attributes and the Army accession environment during the evaluation period. The study cohort will be considered a representative sample of the current Army accession population.

Methods of Generating REQUEST MOS Training Lists

The availability of MOS training opportunities to individual recruits at the MEPS are generally driven by recruit qualifications, MOS vacancies, the updated training seat schedule, accession requirements, and quality distribution goals within and across MOS. Open MOS for which a recruit is qualified are ranked according to Army recruiting and fill priorities by REQUEST. The overriding objective of managing the availability of class seats is the efficient use of training resources in meeting Army accession goals.

REQUEST employs an elaborate procedure for opening and ranking MOS training class dates, incorporating systematic and subjective factors in the process. The final output of this process is a rank ordered list of MOS training class start dates that reflects recruit characteristics and prevailing Army priorities at the time of the MEPS transaction. Recruits with exactly the same characteristics, for example, may obtain different MOS training lists depending on their signing dates, real time changes in individual MOS fill rates, and shifts in Army priorities.

Two approaches could be employed in this field test to construct the REQUEST MOS class start date list of a recruit. The first procedure is primarily based on the recruit's actual REQUEST list, while the second procedure would be based on simulation procedures that would approximate key mechanisms in REQUEST. These determine availability and rank ordering of MOS training class start dates. We describe below the two REQUEST MOS training list generation methods, discuss for which evaluation periods they are appropriate, and conclude by comparing their respective utilities for the field test.

Fixed Method of Generating the REQUEST Lists

The first approach to constructing MOS training class lists under REQUEST and EER classification conditions relies on the actual training class opportunities presented to recruits at the MEPS, which are contained in the REQUEST transaction database. This simple approach allows us to circumvent simulating complex systematic and subjective factors used by REQUEST to create lists of MOS training classes, with rank ordered class start dates that reflect Army priorities and training schedules. We refer to this as the fixed method of list construction. Below we describe the approach under each classification simulation condition.

REQUEST Classification Simulation Condition

Figure 3 depicts the off-line simulation of REQUEST based on the fixed method of generating the MOS training class list. The operational REQUEST PJM process is represented

by the black box in the center of the diagram. The strategy in the fixed method would be to access directly the REQUEST transaction data, which includes the list shown to each recruit. As mentioned above, this would allow us to bypass the operational inputs shown to the left of REQUEST, as well as the REQUEST process itself. The REQUEST list is shown as the box to the right of the black box PJM process, and is referred to as the fixed actual list to indicate that it is operational data.

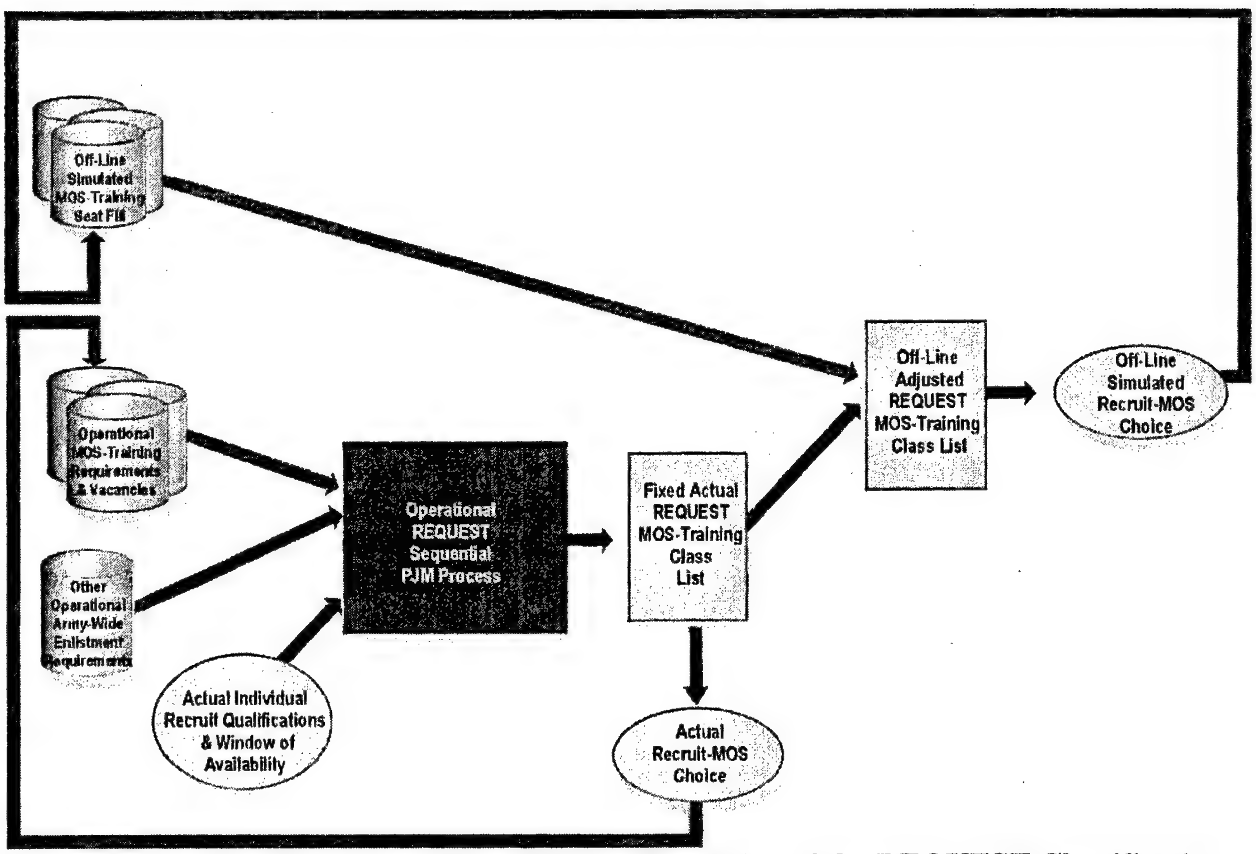

Figure 3. Graphical Depiction of the Off-Line Simulation of the REQUEST Classification System Based on the Fixed Method of Generating the REQUEST List

The fixed REQUEST list would produce an operational MOS and training seat fill pattern at the actual contract date of a recruit that is somewhat different from the pattern in the simulation at the same contract date. This is because the recruit MOS assignment decision-making model in the classification simulations provides random variation in recruit MOS training class choices (indicated by the oval on the right side of Figure 3). A simple adjustment would be made to the actual REQUEST list by dropping MOS training classes that are filled at the recruit's contract date in the simulation. MOS training opportunities that remain according to the simulated classification process will form the recruit's off-line adjusted REQUEST list, which appears to the right of the fixed actual list.

The upper and lower feedback loops in Figure 3 show how the operational REQUEST data and the results of the simulated recruit MOS choices update the operational and simulated classification systems, respectively. The recruit assignment choice in the simulation is fed back (upper loop) to an off-line database that contains continuously updated MOS and training seat

vacancies. These updates are used to adjust the fixed actual list. The lower loop indicates that actual recruit choice, which is based on the fixed list, is fed back into the operational REQUEST system by updating actual MOS and training seat vacancies. The operational updates become REQUEST inputs that impact subsequent fixed lists.

At the beginning of the evaluation period, the difference in operational and simulated fill patterns is expected to be relatively small, as simulation and actual assignments will start with the same initial schedule, and then becomes larger as subsequent assignments are made. However, the discrepancy between actual and off-line fill patterns will be restricted for the following reasons. First, through currently tight DEP management control mechanisms, the window of available class start dates in a REQUEST list is typically confined to a few weeks from the signing date of a recruit (except for high school seniors). Second, in the off-line assignments of recruits, adjustments will mostly be made by dropping filled training classes from the typically large lists of class start dates associated with MOS on the original list. The combination of these two factors will have the desired effect of keeping the off-line, simulated, recruit assignment pattern close to that which actually will be realized during the evaluation period.

EPAS-Enhanced REQUEST Classification Simulation Condition

Figure 4 is a diagram of the EER simulation based on the fixed method of generating the REQUEST list. Examination of the process shows that EPAS and REQUEST will obtain MOS and training seat vacancy updates (shown on the left side of the figure) from two different sources, unlike the proposed operational system that would use the same source. If the fixed method is used in the simulations, a separate off-line database of continuously updated fill patterns will be set up as an input for EPAS through the contract mission database and the PJM process, which will be run off-line because it is not operational. Since the fixed method uses operational REQUEST, actual MOS and training seat fill patterns will be inputs to REQUEST. The operational list is relabeled the fixed actual REQUEST list in the simulations because the list for a recruit becomes a fixed data point.

As in the REQUEST classification simulation based on the fixed method, EPAS-enhanced REQUEST would use the simulated MOS and training seat vacancies to create an off-line adjusted REQUEST list, in which MOS training opportunities that were filled to capacity in the simulation process would be dropped. However, the process of creating the list does not stop there. The adjusted REQUEST list is merged with the EPAS optimal guidance (EOG) that reorders it using EPAS-REQUEST merge rules. Simulated recruit choices are made with the MOS assignment decision-making model. The results are fed back to the off-line MOS and training seat vacancy database used to adjust the REQUEST list so that it accounts for previous off-line assignments and as an input to EPAS.

If EPAS reordering of MOS training classes is significant, we could observe a substantial difference between the fill patterns from off-line simulated classification under fixed EER and fixed REQUEST simulation conditions. This difference, however, will likely be limited because the lists used for off-line classification under the two conditions originate from the same actual REQUEST MOS training list. A similar constraint would occur in an operational EER system,

because currently tight DEP management controls would keep the REQUEST and EER fill patterns from diverging too much.

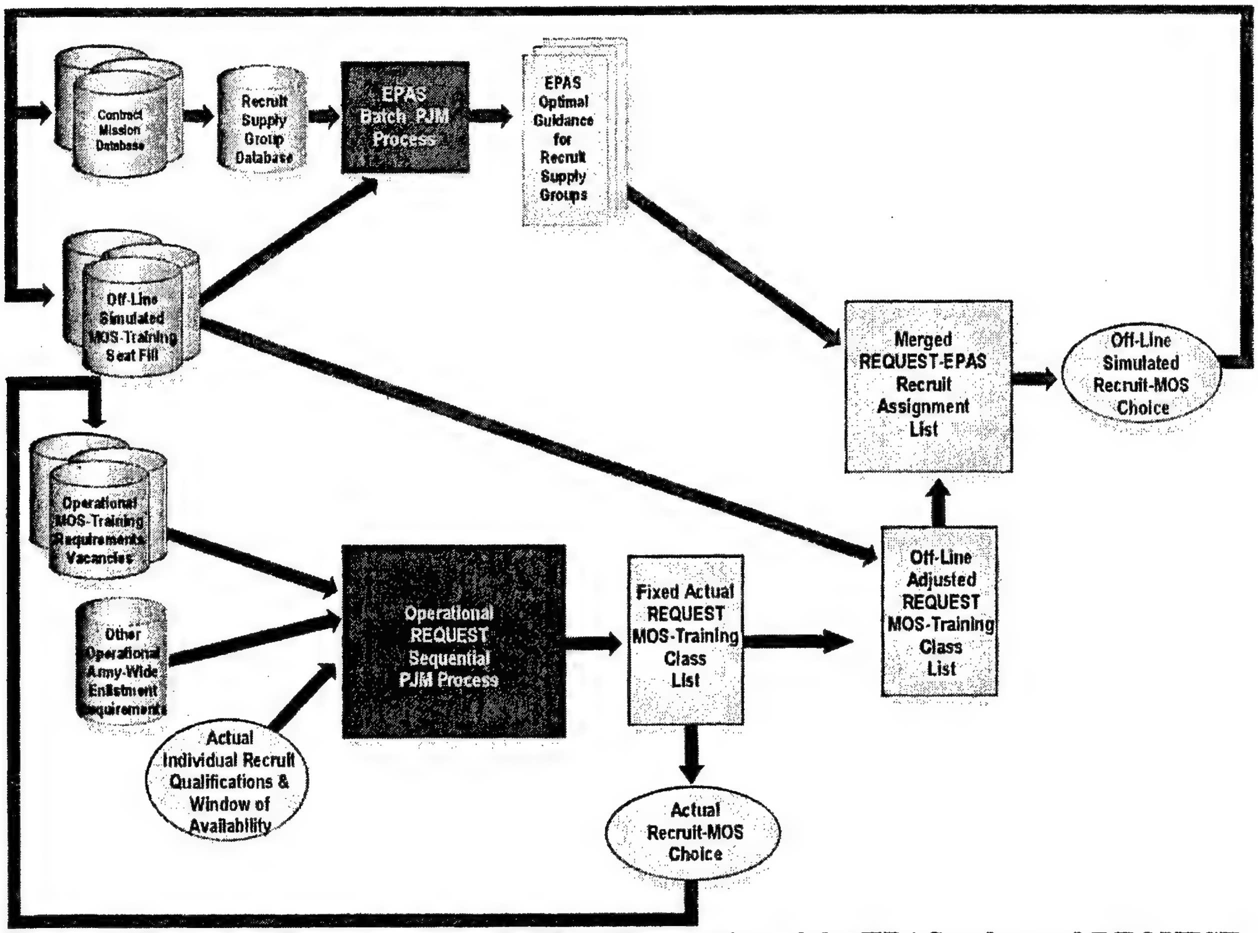

Figure 4. Graphical Depiction of the Off-Line Simulation of the EPAS-enhanced REQUEST Classification System Based on the Fixed Method of Generating the REQUEST List

Dynamic Simulation Method of Generating the REQUEST List

We describe in this section a second method for generating the REQUEST MOS training class lists for the REQUEST and EER classification system simulations. This procedure is designed to circumvent the weaknesses of the fixed method described above (i.e., the underestimation of cumulative effects). The fixed method would use the actual monthly MOS and training seat requirements and vacancies (i.e., the Army's actual demand data). These data would be based on monthly operational REQUEST assignments and adjustments to Army MOS training requirements made during the evaluation period. The dynamic simulation method of generating MOS training class lists involves synthetically constructing off-line the REQUEST sequential person-job matching process in both the REQUEST and EER classification conditions. The significant challenges of developing this procedure are outlined in the next section.

Challenges of Developing the Dynamic Simulation Method of Generating the REQUEST List

Devising a method for constructing a dynamically simulated REQUEST list that will accurately represent operational REQUEST in the off-line field test is a complex and difficult task. The method should account for periodic changes in numerous factors such as the ranking of priority MOS, and the intricate DEP management process employed by PERSCOM to control MOS training class seat availability over time. While both priority MOS ranking and DEP controls, for example, have rational bases that support Army recruiting goals, they also involve partly subjective decisions.

The goal of the dynamic method is not the complete off-line reproduction of procedures underlying operational REQUEST. This would be impossible because the subjective components of the REQUEST PJM process cannot be adequately modeled. The goal would be to develop a model of REQUEST that meets a predetermined standard in samples of recruits taken from the field test database. The two key features that must be modeled validly and reliably in the dynamic method are management of the DEP length and the ranking of priority MOS, which reflect variable Army accession and classification goals.

Another feature of REQUEST that could be modeled is the periodic update of the training class schedule, which adjusts for DEP loss, progress in meeting recruiting goals, and possible changes in recruiting policy. Modeling of operational updates should be done in conjunction with analyzing why and how update decisions are made so that the time element is captured accurately in the off-line REQUEST simulation. Other factors that impact the REQUEST PJM process through the availability of training seats are the sharing of MOS quotas for the Regular Army, National Guard, and Reserves, and the relaxing of MOS quotas for female recruits, as assignments are made close to class start dates.

The rational elements that determine important features of the REQUEST PJM process could be accounted for analytically more or less depending on the amount and quality of available information, but the task would be time consuming. Using MOS priority ranking as an example, the rational elements would be represented by the algorithm of approximately 10 weighted operational variables used by PERSCOM to determine a preliminary ranking. The variance accounted for by the subjective elements could be partially estimated by comparing the preliminary order to the PERSCOM actual ranking. Similar techniques could be used with the other important features of REQUEST, but there is no way to know in advance how realistic the dynamic method would be in simulating the MOS training class list.

REQUEST Classification Simulation Condition

If the dynamic method is used in the field test to generate the REQUEST list off-line, the MOS training class opportunities would be dynamically simulated in turn for each recruit, by order of their actual contract date, under the REQUEST simulation condition. Overall, the construction of the *dynamic REQUEST list* will be a two-step process. The initial step will be determining the composition of the list, which will involve mechanisms for screening MOS and training start dates, based on recruit qualification, DEP management, and training class scheduling factors. The eligibility of a recruit for different MOS training options will be

determined primarily by AA cut scores and gender restrictions. Recruit physical attributes and security requirements should be included in the simulated model of the REQUEST PJM process for certain MOS. After the composition of the list is finalized, the next step is to rank order the training opportunities in the list to reflect Army recruiting priorities. All information required in this two-step, simulated REQUEST list construction process will be based on dynamically updated MOS and training class fill rates associated with the actual recruit and his or her contract date in the off-line simulation environment.

Figure 5 graphically demonstrates how the dynamic simulation method of generating the REQUEST list would be carried out in the field test.[7] As we stated above, the basis of this method is a model of the REQUEST PJM process that would be developed as part of the field test. The black box in the center of Figure 5 represents simulated REQUEST. It would be developed using the facets of REQUEST that are most important in determining the composition and rank ordering of the MOS training class list. These include external, operational factors represented by two of the three icons to the left, and feeding into the REQUEST model.

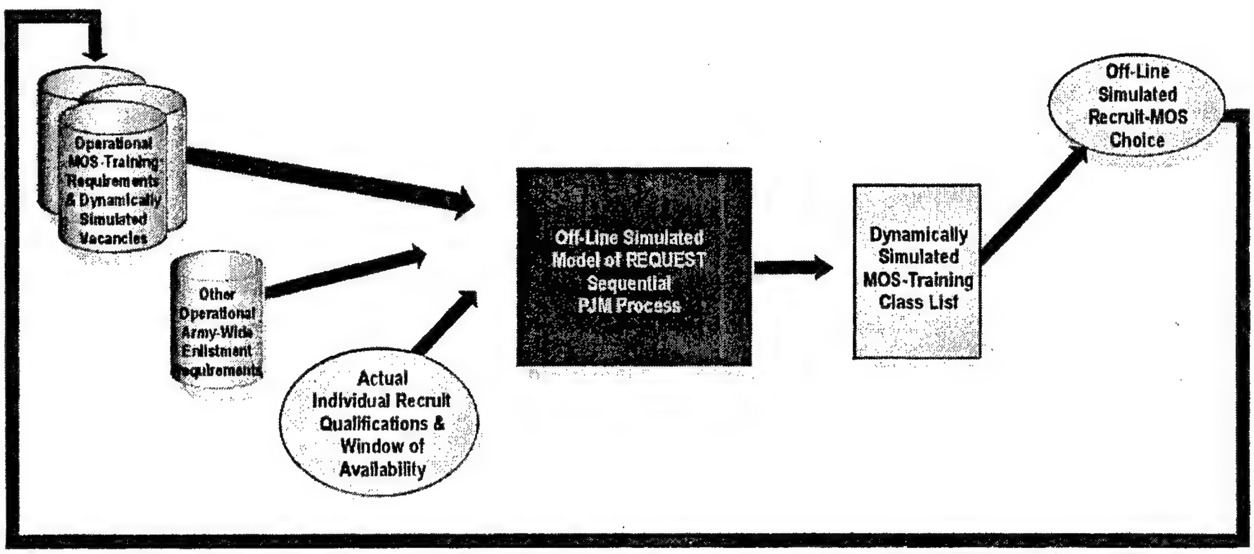

Figure 5. Graphical Depiction of the Off-Line Simulation of the REQUEST Classification System Based on the Dynamic Simulation Method of Generating the REQUEST List

Looking at the top left of Figure 5, the first database consists of the actual, operational MOS and training requirements established by Army policy makers for the FY evaluation period. The second database consists of the continuously updated fill rates for MOS and training class seats. The off-line simulation process used in this field test is a technique for comparing REQUEST and EPAS-enhanced REQUEST under realistic conditions using actual recruit supply

[7] Note that operational REQUEST is a dynamic system in the sense that it is an iterative, feedback process. We use simulation to refer to both the modeling of REQUEST (i.e., it simulates, or is a synthetic version of, operational REQUEST) and that the overarching field test strategy is an off-line simulation of the Army's classification process, a major component of which is REQUEST. Although the dynamic simulation method of generating the REQUEST list results in a purely off-line, simulation field test (while the fixed method relies on operationally produced REQUEST lists, which become part of the off-line simulation process), actual recruit supply, and MOS and training demand, data are inputs into the REQUEST model. The operational data and accuracy of the REQUEST PJM model make independent contributions to the fidelity of this approach to the field test simulations.

and MOS and training class demand data. Updating MOS and training vacancy data occurs off-line with both the fixed and dynamically simulated REQUEST list generation method, and is a direct function of recruit MOS choices (shown on the right of Figure 5), which are modeled in the simulation by the recruit MOS assignment decision-making model. The dynamic method would simulate this process solely on the basis of the off-line simulated assignments. In contrast, the fixed method uses an off-line adjusted REQUEST list formed by accessing the recruit's actual REQUEST MOS training class list and modifying it to reflect the simulated MOS and training fill rates.

The "Other Operational" icon in Figure 5 that feeds data to REQUEST represents all other Army considerations, managed by U.S. Total Army Personnel Command (PERSCOM) and U.S. Army Recruiting Command (USAREC), that impact the REQUEST MOS training class list shown to recruits. Only the most important of these (e.g., the DEP management process and priority MOS) would be included in modeling REQUEST. The third icon, actual recruit qualifications and window of availability, refers to the recruit database, which includes contract start date, for the evaluation period.

In summary, the process of developing the simulated REQUEST PJM model would combine modeling operational recruiting, assignment, and accession processes, which will approximate the operational REQUEST system more or less accurately, with actual recruit characteristics data and operational MOS and training class requirements data. Continuously updated MOS and training seat vacancy data are also part of the model. At the start of the simulation these data would be set to the operational Army values and the simulated REQUEST model would produce what we refer to as a dynamically simulated REQUEST MOS training class list. The data record for the recruit with earliest contract date in the database would serve as the first recruit, and the dynamically simulated REQUEST list would reflect his or her qualifications. The assignment decision-making model is applied to the simulated list to simulate the recruit MOS training class choice. This information would be fed back to the MOS and training seat vacancies database, which would be updated according to the simulated assignment. This would start the second iteration of the classification simulation process, this time with dynamically simulated MOS and training seat vacancies. The process would continue until the data record for the recruit with the last contract date was assigned. This would form 1 of the 30 classification system replications that make up one simulation condition.

EPAS-Enhanced REQUEST Classification Simulation Condition

In the EPAS-enhanced REQUEST simulation condition the dynamically simulated REQUEST list of MOS training opportunities would be constructed exactly as in the REQUEST condition described above. As shown in Figure 6 the difference is that the EPAS optimal guidance list of MOS would be merged with the dynamically simulated REQUEST list. The resulting dynamically simulated EER list would be rank ordered following the same merge rules as those of the proposed operational system. The procedure for simulating a recruit's MOS training class choices also would be the same as in the REQUEST condition.

Figure 6 shows that the result would be fed back to update the MOS and training class vacancies. The updates would be input into both REQUEST and EPAS PJM processes. The

dynamic method would create EER lists that reflect fill rates from purely simulated recruit MOS training choices.

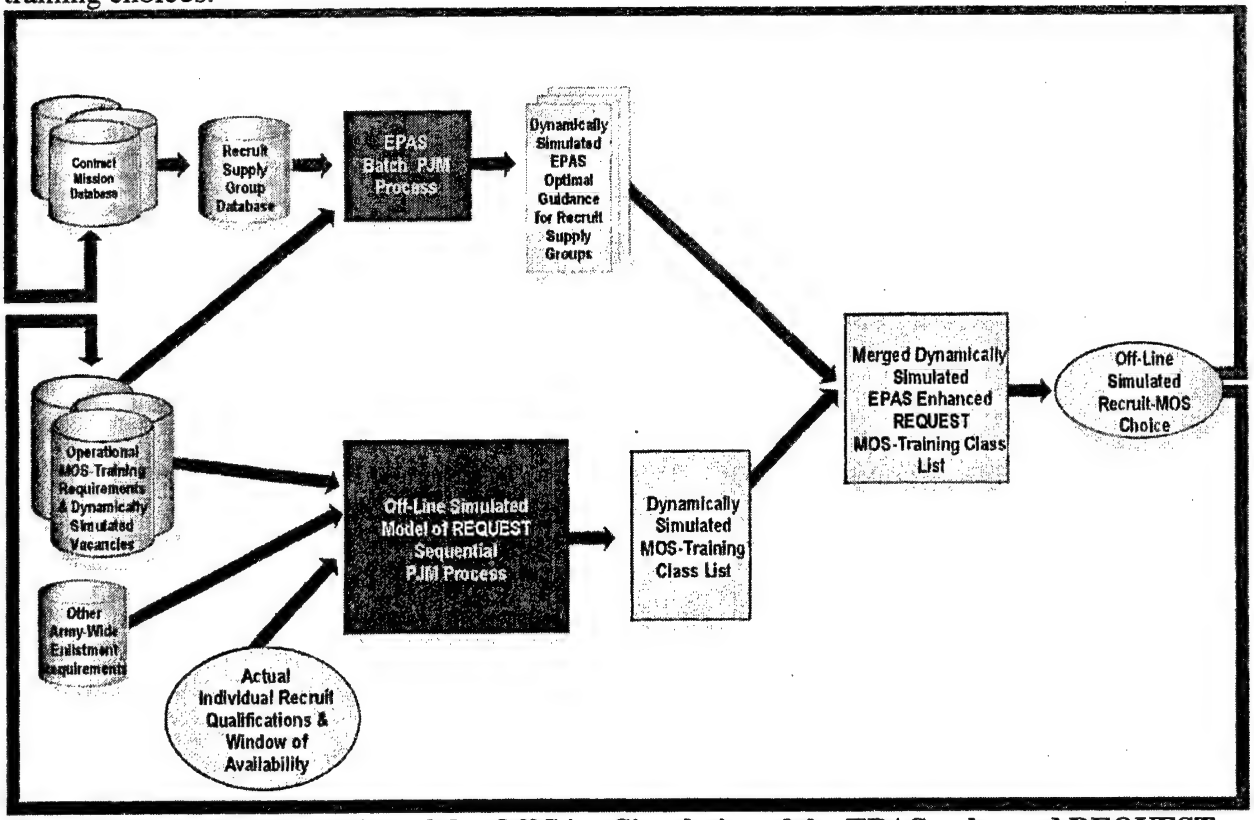

Figure 6. Graphical Depiction of the Off-Line Simulation of the EPAS-enhanced REQUEST Classification System Based on the Dynamic Method of Generating the REQUEST List

Strengths and Weaknesses of Fixed and Dynamic Simulation Methods of Generating the REQUEST List

Irrespective of the method of generating the REQUEST list, the off-line classification simulations of both REQUEST and EPAS-enhanced REQUEST would not be as accurate as conducting a fully operational evaluation under optimal conditions. However, a successful operational evaluation would be difficult, if not impossible, and expensive to conduct. The major drawbacks to an operational field test are constraints related to disrupting recruiting, accession management, and assignment procedures, and the difficulties of devising and implementing strategies for obtaining adequate, independent samples of assignments made with the two systems.

The strength of the dynamic simulation method of generating the REQUEST lists is that it provides the basis for conducting the classification simulations of both REQUEST and EPAS-enhanced REQUEST completely off-line in a manner that closely imitates the operational processes. In contrast, the fixed method of generating the REQUEST lists accesses the actual (i.e., fixed in the database) MOS training class lists shown to the recruits. The lists then are adjusted to drop any MOS training classes that were filled to capacity by preceding assignments

in the simulations. The adjustment adds a source of error to the simulations that is not present with the dynamic method.

The advantage of the dynamic list generation method will be small in the first few months of the evaluation period because the differences in the MOS and training class vacancy patterns between the fixed list, which is taken from operational REQUEST, and the dynamically simulated list will be small. The differences will increase over time, resulting in more adjustments of the lists to account for the simulated fill patterns that occur with the fixed method. We would expect the fixed method of generating the REQUEST list to be adequate for the REQUEST condition for the 6-month evaluation period, while the dynamic method is preferable for the 12-month field test. As we discuss below, the dynamic approach would be best for evaluating EPAS-enhanced REQUEST in both evaluation periods.

The dynamic method of generating REQUEST lists will be most beneficial for evaluating the EER system. This is because the EPAS optimization procedure places a high weight on the match of recruits to MOS in which they are expected to perform well according to their AA scores. This effect provides cumulative benefits by yielding MOS and training seat vacancy patterns that would be favorable for subsequent recruit assignments in terms of person-job fit. Naturally, this effect will be larger if lists are created dynamically as EPAS would not be constrained by the fixed actual REQUEST MOS and training class list. The EPAS feature of using contract mission "forecasts" in the optimization procedure to facilitate optimization throughout the year would also function more freely with dynamically simulated list construction for the same reason.

Another strength of the dynamic simulation approach under the EER condition is the possibility of studying the effects of alternative DEP lengths.[8] Relatively long DEP periods should allow the contract mission forecast feature of EPAS to produce better recruit-MOS matches than short periods. This analysis could not be conducted with the fixed method of generating REQUEST lists, because the actual lists would reflect only the current operational DEP length policy.

In summary, the dynamic simulation method of generating REQUEST lists would provide more accurate off-line simulation results than the fixed method if the REQUEST system could be adequately and accurately modeled. This is because the REQUEST and EER classification systems would use the simulated recruit MOS training class choices and resulting off-line fill rates as inputs to their PJM processes without being constrained by operational assignments derived from the fixed actual REQUEST lists. We describe above, in the section entitled "Challenges of Developing the Dynamic Simulation Method of Generating the REQUEST List", the complexities involved in accomplishing this. We note that there is a large subjective (and necessary) component in the Army's operational classification system that would be difficult to estimate. Further, changes in accession requirements, recruit supply, and external

[8] This would be the case for the REQUEST condition, too, but REQUEST does not include a feature that uses contract mission forecasts to optimize person-job matches beyond the current month, as does EPAS. Therefore, EPAS is more likely to show practically significant benefits than REQUEST. A test of the two systems with different DEP lengths would be the ideal.

economic, political, and social factors during the FY would add to the modeling process. In addition, the REQUEST modeling process would be time consuming and expensive.

Although the dynamic method has many strengths, we recommend that the fixed approach be used in the current off-line field test, especially for the 6-month analysis and the monthly analyses, if they are included. We believe that the expense of the dynamic method and the expected inaccuracies in emulating both the systematic and subjective dynamic factors in REQUEST would probably outweigh the error component introduced by constraining the simulations in the fixed method to use the actual REQUEST list.

The main strength of the fixed list over the dynamic list approach discussed is the relative ease of conducting the simulation procedure because the operational REQUEST list for each recruit (i.e., the fixed actual list) will be contained in the REQUEST transaction database. This will avoid much of the costs of the dynamic method. The major weakness of the fixed list method in fully accounting for dynamic changes in MOS and training class fill patterns, when comparing REQUEST and EER conditions, is that the functional constraint on EPAS will be greater than that on REQUEST. The operational REQUEST assignments will be closer to the simulated REQUEST assignments because the PJM procedures are the same. The fixed list approach will provide lower bound, or conservative, estimates of EPAS benefits, because its PJM optimization algorithm is constrained by the fixed REQUEST list generation method that uses a far less complicated list construction method. If a more precise evaluation of EPAS potential, possibly using varying DEP lengths, were desired now or in the future, an implementation of the dynamically simulated list construction approach would be essential.

In conclusion, the common dependence of the REQUEST and EER simulated classification systems on fixed actual REQUEST MOS and training class lists will not be as limiting as would initially appear. The fixed method is meaningful and defensible as the more simplified off-line simulation mechanism in light of the currently short DEP lengths, which will dampen EPAS optimization potential. EPAS will be able to create PJM efficiencies through its optimization procedure to some extent, and in the process accumulate some benefits throughout the FY, within the constraint of the DEP management controls in effect during the evaluation period. The fixed method of generating the REQUEST list will be easier and less expensive to develop. If a more accurate evaluation of EPAS is desired later on, then a dynamic simulation could be considered with examination of various DEP lengths.

MOS Assignment Decision-Making Model

The final component in the proposed field test is a statistical decision-making tool for generating off-line MOS training assignments from non-enhanced and EER lists of recruits. It may be viewed as an analytical replacement for the actual assignment transaction between the recruit and guidance counselor at the MEPS. In other words, the MOS assignment decision-making model will stand in for the actual recruit MOS training class choices in the off-line classification simulations conducted in both the REQUEST and EER conditions. The decision-making model is a necessary technique for conducting realistic simulations of operational or proposed classification systems. A brief description of the model is provided below. The preliminary technical overview is presented in Appendix A. A sample of operational REQUEST

transaction data is needed to specify the model. This will be conducted early on in the field test using three months of data. The model will be validated and modified, if necessary, with the full 12-month data set.

The MOS assignment decision-making model is probabilistic. It will statistically represent recruit MOS training class choices in the off-line simulations. The idea is to specify an equation that will yield "choice" probabilities, which is consistent with the recruit attribute-MOS training class choice pattern revealed in the REQUEST transaction data. In the off-line simulations, the decision-making model equation will assign probabilities to the MOS training class opportunities that appear in the REQUEST or EER list of a recruit in the database. The probabilities will determine the odds that an individual will select each alternative MOS training class start date in the list, given attributes of recruits, the composition and ranking of MOS and training classes, as well as other transaction variables. Each recruit's synthetic (i.e., simulated) MOS training class start date choice will be stochastically selected in each replication of the off-line classification simulations based on the computed odds. This means that the same recruit may be assigned to a different MOS training option in his or her list in each replication, all else equal.

Note that each recruit in the database actually enlisted on a specific contract date during the evaluation period and chose a specific MOS and training class. In the REQUEST and EER simulations the recruits' actual choices will be ignored, and the recruit MOS decision-making model will be run to make a synthetic MOS training class choice. Because the statistical model is generated from the REQUEST transaction data, the results of the simulated recruit choices, averaged over 30 replications of the classification simulations, are expected to mirror the observable choice behavior of the actual recruits in the operational Army classification process.

The task in developing the stochastic MOS assignment decision-making model is to describe observable recruit MOS training class choice behavior using the variables available in the REQUEST transaction database. A basic assumption of the model is that recruit job choice behavior is to some extent rational (i.e., not random). For instance, it is not unreasonable to presume that a recruit who is equally attracted to two MOS that are presented at the top of the MOS training class list would favor the job with the greater bonus. Or suppose a recruit is offered two MOS with aptitude requirements that are quite different, all other factors equal. The guidance counselor involved in the transaction may point this out to the recruit, influencing him or her to choose the job that is closer to his or her ASVAB test score profile.

In our modeling approach, we consider two types of explanatory variables: MOS-specific and recruit-specific attributes. MOS-specific variables, which may be significantly related to recruit assignment choices, may include enlistment bonuses, incentives, term of enlistment, training start dates, and MOS composition and rank order in the list. An additional MOS attribute may be its attractiveness to recruits. Our preliminary research indicates that MOS attractiveness variables (e.g., work requirements and ease of skill transfer to the civilian sector) may make statistically significant contributions to the model. We will only be able to obtain a vague indication from the REQUEST transaction data about whether this hypothesis seems worth pursuing. We plan to conduct a limited information gathering procedure to develop and measure variables that tap this possible component of the model. We will do this by conducting brief structured phone interviews with a small sample of guidance counselors in a sample of MEPS

(Military Entrance Processing Station). Recruit-specific attributes we will test for inclusion in the model will be ASVAB test scores, education level and demographics. Counselor identity and MEPS location will also be considered as recruit-specific explanatory variables.

IV. FIELD TEST DESIGN DETAILS

This chapter describes our technical approach in evaluating the impact of the EPAS enhancement of REQUEST on the Army recruit classification system. It will be divided into three sections. In the first section, we give an overview of the three evaluation periods under which the different field test research questions will be analyzed. We also identify other field test parameters that will characterize the off-line simulation of the Army classification system, in addition to the REQUEST and EER conditions. In the second section, we provide the technical descriptions of the indices that will be employed in analyzing the different study questions. The third section provides technical guidelines in carrying out the different analyses under each of the three evaluation periods.

Overview

Three Sets of Evaluation Periods

Initial monthly assessments of the impacts of EPAS enhancement of REQUEST will be carried out using REQUEST transaction data from the first six months of the field test period. These monthly analyses will be limited to two or three of the first six months of the field test. The main advantage of these preliminary analyses is that they would provide timely results regarding the classification benefits of EPAS enhancements of REQUEST. These results, however, are not cumulative and therefore are expected to underestimate potential EPAS benefits. The preliminary monthly analysis will be based on the fixed actual REQUEST list.

A second set of intermediate analyses will be carried out using a six-month evaluation period, again based on the fixed actual REQUEST list. Results from these intermediate analyses could begin to show cumulative effects of EPAS, even if they will remain constrained by fixed actual REQUEST training choices of recruits. These results are expected to provide better estimates of the impact of EPAS enhancements on REQUEST compared to the results of the preliminary analyses.

A final set of analyses will be carried out for the full fiscal year evaluation period. These analyses will be carried out using fixed actual REQUEST lists or dynamically generated REQUEST lists, depending on the feasibility of the latter. The results from these 12-month period analyses will represent the variety of recruits and conditions met during a fiscal year. Consequently, these results will more accurately reflect the overall cumulative impact of EPAS on REQUEST compared to the preliminary monthly and intermediate analyses, regardless of the type of the list that will be employed. A more accurate measure of potential EPAS cumulative classification benefits is expected under dynamically generated REQUEST lists, if feasible, compared to the estimates that will be obtained under fixed actual REQUEST lists.

Additional Classification Condition

Underlying the simulation in the three evaluation periods is a type of job composite, which will impact the analyses for all three types of research questions. The job composite of a classification system plays a dual role in the overall classification process. First, composites are

employed in the initial construction of the list through cut scores. Only MOS for which the recruit meets the minimum standard in the respective job composite can be considered in the list of this recruit. Second, composites also provide guidance in matching the individual to jobs in which he or she is best suited. Informally, this is part of REQUEST in that job composites are available to the career counselor for purposes of advising on a recruit's MOS choice decision. In an EER system, this person-job matching guidance is formally factored in the reordering of MOS in the EER list.

Given the important role of job composites, the manner by which these are computed is central in the overall performance of a classification system. In this study, the impact of EPAS enhancement on REQUEST will be evaluated under two sets of classification composites. The first set of composites will employ the interim least-square weights of seven ASVAB subtest scores on the existing nine Army aptitude areas. The second set of composites will be based on the least-square weights of seven ASVAB subtest scores on the 17 job family configuration of Johnson and Zeidner.[9]

An unresolved problem related to job classification composites is how to handle eligibility of recruits to various MOS, if the job composite parameter is set to something other than the current nine family unit weighted composites. For instance, "equivalent" cut scores will need to be defined before off-line evaluations can begin. This will not be a problem if the job composite parameter is the same as the set of composites that are operational during the field test, as recruits will be eligible for all jobs in their actual REQUEST lists.

Simulation Condition Combinations

Employing all combinations of conditions and parameters in the field test will entail a large analytical and computing effort. The combinations of evaluation periods, job composites, and type of classification system are shown in the table below. Using only three preliminary monthly analyses, this table represents a total of 20 separate simulations, each of which will involve a total of 30 replications. Separate job list, classification efficiency and accession analyses will be carried out for each of the 10 corresponding pairs of REQUEST and EER simulations.

Table 1
Potential Field Test Classification Conditions and Job Family Composites by Potential Evaluation Periods

Evaluation Period	Job Composites		Classification System		Total
	9-JF	17-JF	REQUEST	EPAS-enhanced REQUEST	
(3) Monthly Analyses	3	3	3	3	12
6-Month Analyses	1	1	1	1	4
12-Month Analyses	1	1	1	1	4

[9] For a description of the 17 job family configuration, see P. Greenston (2002), *Proposed New Army Aptitude Area Composites: A Sumary of Research Results*, Study Report 2002-03. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

We recommend that the preliminary and intermediate evaluations focus on the combination of job composites and optimization that more likely will be recommended for implementation, so as not to defeat the advantage of timely feedback from these initial evaluations. For the final evaluation, a judicious choice of study parameter combinations can be considered.

Analysis Indices

Detailed descriptions of the field test analysis indices are organized into three sections according to the type of research question under consideration, without regard to the length of evaluation period. In order, these are job list analysis indices, classification efficiency analysis indices, and accession analysis indices.

Job List Analysis

The indices that will be employed in the job list comparison analyses are described below. The discussion is structured by specific job list comparison research question associated with the indices.

Size of Intersection Between REQUEST and EPAS Lists Analysis

The first type of job list analysis will examine the size of intersection between the REQUEST list and EPAS list of job opportunities. In this analysis, the length of the intersection for each recruit will be represented either by the count

$$YN(i,r) = \begin{pmatrix} \text{number of common MOS - class start dates in the REQUEST and} \\ \text{EPAS lists of the } i\text{th recruit at the } r\text{th assignment replication} \end{pmatrix}$$

or the equivalent form in proportion

$$YP(i,r) = \frac{\begin{pmatrix} \text{number of common MOS - class start dates in the REQUEST and} \\ \text{EPAS lists of the } i\text{th recruit at the } r\text{th assignment replication} \end{pmatrix}}{\text{length of REQUEST list of the } i\text{th recruit}}.$$

These two forms of the intersection will be employed in the computation of the following job list analysis indices.

Overall Analysis. The intersection between REQUEST and EPAS lists of all recruits in the simulation of a specified evaluation period will be summarized by replicate using the indices

$$\overline{YN}(r)=\frac{YN(1,r)+YN(2,r)+YN(3,r)+\cdots}{\text{total recruits in the evaluation period}}$$

$$\overline{YP}(r)=\frac{YP(1,r)+YP(2,r)+YP(3,r)+\cdots}{\text{total recruits in the evaluation period}}$$

The index $\overline{YN}(r)$ is just the average of the number of common MOS-class start dates of all recruits in the rth simulation replication. The index $\overline{YP}(r)$ is an analogous average but calculated using the proportion form of the size of intersection relative to the length of the respective REQUEST lists of recruits.

The proportion form of the index is recommended over the count form if the lengths of REQUEST lists vary substantially across recruits for the following reason. In the computation of $\overline{YN}(r)$, recruits with longer REQUEST lists likely will be weighted more than recruits with shorter lists. This, however, will not be a concern for $\overline{YP}(r)$ as the contributions of all recruits are put in the same scale, without regard to the actual lengths of their respective REQUEST lists.

Subgroup Analysis. A separate set of indices will be computed using the same simulation replicate for conducting subgroup analysis of the size of intersection between REQUEST and EPAS lists, based on recruit gender, AFQT, and education levels. The names used to label these three subgroup factors are shown in the table below under the ***CAT*** column. Also shown in the table are the subgroup levels that will be analyzed for each factor, which are shown inside the parenthesis under the ***GRP*** column next to the their respective group value. The variables *CAT* and *GRP* are used in the subgroup indices below and in the remainder of this section, to represent in general notation the factor (*CAT*) and a specific subgroup (*GRP*) combination.

Table 2
Subgroup Analysis Factors and Levels

Type of Subgroup Analysis	***CAT***	***GRP***
By recruit gender	*SEX*	M (male), F (female)
By recruit AFQT	*TSC*	A (I-IIIA), B (IIIB), C (IV)
By recruit education level	*EDUC*	G (HS Grad.), S (Senior), N (Non-grad.)

In general, to carry out subgroup analysis of size of intersection using factor *CAT*, the intersection between the REQUEST and EPAS lists will be summarized by subgroup level of the factor for each simulation replication. The count and proportion forms of the index for a specific factor by subgroup combination are

$$\overline{YN}_{CAT}(GRP,r) = \frac{\text{sum of } YN(i,r) \text{ for all recruits in subgroup } GRP \text{ of factor } CAT}{\text{total recruits in subgroup } GRP \text{ of factor } CAT}$$

$$\overline{YP}_{CAT}(GRP,r) = \frac{\text{sum of } YP(i,r) \text{ for all recruits in subgroup } GRP \text{ of factor } CAT}{\text{total recruits in subgroup } GRP \text{ of factor } CAT}$$

These indices are just the averages of the count (*YN*) or proportion (*YP*) of common MOS-class start dates of recruits in the *r*th simulation replication computed by subgroups of *CAT*.

We briefly illustrate the subgroup notation above by looking at the subgroup analysis by gender. For this example, the factor *CAT* equals *SEX*, and the relevant subgroup values are *GRP=M,F*. Using the count form of the index, we will compute $\overline{YN}_{SEX}(M,r)$ and $\overline{YN}_{SEX}(F,r)$ to represent the average number of common MOS-class start dates for male and female recruits, respectively, in the *r*th simulation replication. The analysis of interest in this example would be the comparison of the size of intersection of REQUEST and EPAS lists between male and female recruits.

Quality of the Intersection Between REQUEST and EPAS Lists Analysis

The preceding indices of size of intersection are based on $YN(i,r)$, the simple count of common MOS-class start dates in the REQUEST and EER lists of the *i*th recruit. A limitation of the measures of size of intersection based on $YN(i,r)$ is that all common MOS-class start dates contribute equally, regardless of their respective rank orders in the EPAS list, or their respective movements in rank order locations from the original REQUEST list to the EER list.

The EPAS rank order and movement in REQUEST rank order locations are two important criteria in constructing an index of the "quality" of the intersection. In addition to counting the number of common MOS-class start dates, this index also provides an indicator of their contributions to the overall EPAS person job-matching enhancement of the REQUEST list. Using these two criteria, for example, we would give more weight to an MOS-class start date that moves from the bottom of the original REQUEST list to near the top of the EER list. Moreover, its contribution to the value of the quality index of intersection will be larger if it is at the same time close to the top of the EPAS list.

The indices that will follow are based on $QP(i,r)$, which represents the quality of intersection between the REQUEST and EPAS lists of the *i*th recruit. This quality value is of the form

$$QP(i,r) = \frac{QM(1,i,r) + QM(2,i,r) + QM(3,i,r) + \cdots}{\text{length of the REQUEST list of the } i\text{th recruit}},$$

which is the average of quality contributions of the MOS training opportunities in the REQUEST list of the *i*th recruit. The numerator above is the sum of the "*QM*" values of the MOS training

opportunities in the REQUEST list of the *i*th recruit. The exact definition of $QM(m,i,r)$ is given in Appendix B.

Less formally, $QM(m,i,r)$ is equal to 0 if the *m*th REQUEST training opportunity of the *i*th recruit is not in the EPAS list. $QM(m,i,r)$ is equal to 1 if the *m*th REQUEST training opportunity is in the EPAS list, but its priority rank order in the EPAS-enhanced REQUEST list is lower than originally in REQUEST. $QM(m,i,r)$ is a number between 1 and 2 if the *m*th REQUEST training opportunity is in the EPAS list, and its priority rank order in the EPAS-enhanced REQUEST list is higher than originally in REQUEST. (The actual value of $QM(m,i,r)$ is closer to 2 than to 1 if the *m*th REQUEST training opportunity appears near the top of the EPAS list and, originally, near the bottom of the REQUEST list.) A more rigorous discussion of $QM(m,i,r)$ is given in Appendix B.

Overall Analysis. The quality of the intersection between the REQUEST and EER lists of recruits will be summarized by simulation replicate using the index

$$\overline{QP}(r) = \frac{QP(1,r) + QP(2,r) + QP(3,r) + \cdots}{\text{total recruits in the evaluation period}}.$$

This is just the average of the quality of intersections across all recruits in the evaluation period. From the description of $QP(i,r)$ above, it is not difficult to verify that $\overline{YP}(r) \le \overline{QP}(r) < 2\overline{YP}(r)$. Given this relationship, the difference $\overline{QP}(r) - \overline{YP}(r)$ would be a meaningful index of potential EPAS enhancement that is due solely on its reordering of the original REQUEST list, without regard to the number of matching MOS-class start dates in the intersection.

Subgroup Analysis. The indices that will be employed in the subgroup analysis of quality of intersection between the REQUEST and EPAS lists of recruits will be constructed as before. To carry out a subgroup analyses based on a fixed factor *CAT*, the index of the quality of intersection

$$\overline{QP}_{CAT}(GRP,r) = \frac{\text{sum of } QP(i,r) \text{ over all recruits in subgroup } GRP \text{ of factor } CAT}{\text{total recruits from subgroup } GRP \text{ in the evaluation period}}$$

will be computed for all possible subgroup values of *GRP* associated to the factor.

Size of Intersection Disregarding Date of Availability

A slightly modified length of intersection may also be considered by ignoring class start dates, and instead using only the MOS to match training opportunities in the REQUEST and EPAS lists of recruits. Using this approach, a training opportunity in the REQUEST list will be counted if the associated MOS appears in the EPAS list, even if the month of the REQUEST class start date does not match any EPAS class month with the same MOS.

The modified length of intersection for each recruit will be denoted in count form by

$$YN^*(i,r) = \begin{pmatrix} \text{number of training opportunities in the REQUEST list of} \\ \text{the } i\text{th recruit with matching MOS in the EPAS list} \end{pmatrix}$$

or in proportion form by

$$YP^*(i,r) = \frac{\begin{pmatrix} \text{number of training opportunities in the REQUEST list of} \\ \text{the } i\text{th recruit with matching MOS in the EPAS list} \end{pmatrix}}{\text{length of REQUEST list of the ith recruit}}$$

Job list comparison analyses based on $YN^*(i,r)$ or $YP^*(i,r)$ can be useful as follow up to analyses based on the first length of intersection, for examining whether EPAS is capturing the MOS but missing out on class months. In turn, this information can be used to recommend possible directions as to how EPAS constructs the optimal guidance list or can suggest alternative REQUEST and EPAS list merge rules.

Overall Analysis. The length of intersection between REQUEST and EPAS list based solely on matching MOS will be summarized for all recruits in the evaluation period by simulation replicate, using the indices

$$\overline{YN}^*(r) = \frac{YN^*(1,r) + YN^*(2,r) + YN^*(3,r) + \cdots}{\text{total recruits in the evaluation period}}$$

$$\overline{YP}^*(r) = \frac{YP^*(1,r) + YP^*(2,r) + YP^*(3,r) + \cdots}{\text{total recruits in the evaluation period}}$$

Again, these are simple averages, respectively, of the count and proportion forms of the modified length of intersection computed using all recruits in the evaluation period.

Subgroup Analysis. The subgroup analysis of the modified length of intersection of a specified factor CAT will be based on the indices

$$\overline{YN}^*_{CAT}(GRP,r) = \frac{\text{sum of } YN^*(i,r) \text{ over all recruits in subgroup } GRP \text{ of factor } CAT}{\text{total recruits from subgroup } GRP \text{ in the evaluation period}}$$

$$\overline{YP}^*_{CAT}(GRP,r) = \frac{\text{sum of } YP^*(i,r) \text{ over all recruits in subgroup } GRP \text{ of factor } CAT}{\text{total recruits from subgroup } GRP \text{ in the evaluation period}}$$

that will be computed for all levels or subgroup values *GRP* of the factor.

Analysis of Priority MOS

The analysis of priority MOS will examine the impact of EPAS enhancement on the MOS choices of recruits by comparing the number of Priority-25 MOS at the top-*n* of the REQUEST and EER lists. This analysis will indicate the consistency of the EPAS enhancement relative to Army priorities, as reflected by the number of Priority-25 MOS in the reordered REQUEST list. The value of *n* will be fixed in this analysis.

This analysis will compare the ordered MOS training opportunities in the REQUEST list of a recruit under the REQUEST simulation condition to the MOS training opportunities in the EER list of the same recruit under the EER simulation condition. (These are the MOS training opportunities that are visible to the recruit under the two classifications systems.) Analysis indices will be constructed separately under the two classification system conditions based on the quantities

$$\begin{aligned} YN_R^{(n)}(i,r) &= \text{count of Priority - 25 MOS at the top - } n \text{ of} \\ &\quad \text{(assignment) REQUEST list of the } i\text{th recruit} \\ YN_E^{(n)}(i,r) &= \text{count of Priority - 25 MOS at the top - } n \text{ of} \\ &\quad \text{EPAS - enhanced REQUEST list of the } i\text{th recruit.} \end{aligned}$$

which are respectively derived from the assignment REQUEST list and EPAS-enhanced REQUEST list.

Overall Analysis. The number of priority MOS at the top-n of REQUEST and EPAS-enhanced REQUEST lists will be summarized by simulation replicate using the indices

$$\overline{YN}_R^{(n)}(r) = \frac{YN_R^{(n)}(1,r) + YN_R^{(n)}(2,r) + YN_R^{(n)}(3,r) + \cdots}{\text{total recruits in the evaluation period}}$$

$$\overline{YN}_E^{(n)}(r) = \frac{YN_E^{(n)}(1,r) + YN_E^{(n)}(2,r) + YN_E^{(n)}(3,r) + \cdots}{\text{total recruits in the evaluation period}}$$

These indices are simple averages of the number of top-*n* priority MOS of all recruits in an evaluation period. As noted later on, the intra-individual differences $YN_R^{(n)}(i,r) - YN_E^{(n)}(i,r)$ will play a role in evaluating the differences between these two indices, as well as between the subgroup indices below.

Subgroup Analysis. The subgroup analysis comparing priority MOS at the top-*n* of REQUEST and EPAS-enhanced REQUEST lists will be based on

$$\overline{YN}^{(n)}_{R,CAT}(GRP,r) = \frac{\text{sum of } YN^{(n)}_{R}(i,r) \text{ over all recruits in subgroup } GRP \text{ of factor } CAT}{\text{total recruits in subgroup } GRP \text{ in the evaluation period}}$$

$$\overline{YN}^{(n)}_{E,CAT}(GRP,r) = \frac{\text{sum of } YN^{(n)}_{E}(i,r) \text{ over all recruits in subgroup } GRP \text{ of factor } CAT}{\text{total recruits in subgroup } GRP \text{ in the evaluation period}}$$

These averages will be computed for all subgroup levels *GRP* of the factor CAT:

Classification Efficiency Analysis

The classification efficiency analysis will examine how EPAS enhancement impacts the person-job matching efficiency of the REQUEST system. The mean predicted performance (MPP) of recruits based on their MOS assignments under REQUEST and EER classification systems will be compared.[10] The analysis will be carried out at the Army organization-wide level and also at the MOS level using the indices described below. The MOS level analysis will be useful in identifying MOS that are negatively impacted in terms of recruit predicted performance, if any, by EPAS enhancement of REQUEST.

Army Organization-wide Level Classification Efficiency

The predicted performance of the *i*th recruit is a weighted sum of the recruit's ASVAB subtest scores, with weights that will depend on the MOS job assignment of the recruit. It will represent his or her contribution in the classification efficiency indices. The predicted performance of the *i*th recruit will be denoted separately under REQUEST and EER simulation conditions by $PP(i,h_R(i,r))$ and $PP(i,h_E(i,r))$, respectively. In these expressions, $h_R(i,r)$ and $h_E(i,r)$ respectively indicate the MOS that is assigned to the *i*th recruit in the *r*th classification simulation replicate through the MOS assignment decision model.

The classification efficiency of the Army organization-wide MOS assignments of recruits in an evaluation period will be summarized by simulation replicate using the indices

[10] Different sets of classification composites will be used to make assignments in the field test. Therefore, a single set of classification composite weights, which represents relevant measures of performance in the MOS in all conditions, is needed to compute equivalent classification efficiency indices across the conditions. These composites are referred to as evaluation composites. The weights in the composite associated with the MOS to which a recruit was assigned are applied to the ASVAB test scores of the assigned recruit. If the classification and evaluation composite weights are computed from the same sample, then a cross-validation procedure must be used to create independent sets of weights. A recruit's composite score in the job to which he or she is assigned, computed from the evaluation composites, is called the predicted performance score. The average of these scores across all recruits and MOS in a single classification replicate is mean predicted performance (MPP), the index of classification efficiency for the replicate. The MPP index for an entire simulation is the average MPP across replicates.

$$MPP_R(r) = \frac{PP(1, h_R(1,r)) + PP(2, h_R(2,r)) + PP(3, h_R(3,r)) + \cdots}{\text{total recruits in the evaluation period}}$$

$$MPP_E(r) = \frac{PP(1, h_E(1,r)) + PP(2, h_E(2,r)) + PP(3, h_E(3,r)) + \cdots}{\text{total recruits in the evaluation period}}$$

respectively, under REQUEST and EER simulation conditions. These indices are the simple averages or means of predicted performances under the two classification systems. Each index can vary across simulation replications depending on the MOS assigned to recruits by the MOS assignment decision model in the independent replications.

MOS Level Classification Efficiency

The classification efficiency of MOS assignments of recruits at the MOS level will be summarized separately under the two classification conditions by replicate using the indices

$$MPP_R(m,r) = \frac{\text{sum of } PP(i, h_R(i,r)) \text{ of recruits in the } m\text{th MOS during the } r\text{th replicate}}{\text{total recruits in the } m\text{th MOS during the } r\text{th replicate}}$$

$$MPP_E(m,r) = \frac{\text{sum of } PP(i, h_E(i,r)) \text{ of recruits in the } m\text{th MOS during the } r\text{th replicate}}{\text{total recruits in the } m\text{th MOS during the } r\text{th replicate}}$$

where m indicates a specific MOS. These indices are based on the same recruit MOS assignments used in the Army organization-wide level indices, but employing only recruits assigned to the mth MOS. The comparison of $MPP_R(m,r)$ and $MPP_E(m,r)$ will look at possible differences in classification efficiency at the MOS level under the two conditions.

Accession Analysis

The third type of analysis will focus on how EPAS enhancement of REQUEST impacts Army accession goals. Accession analyses that are considered in this study are divided into three parts. First, we look at the overall Army monthly accession goals under REQUEST and EPAS-enhanced REQUEST assignment conditions. Second, we examine monthly accession goals of priority MOS under the two conditions. The third set of analyses are again concerned with priority MOS but focusing on fiscal year accession goals. The relevant evaluation indices in each of these analyses are described separately below.

Overall Army Monthly Accession

The first accession analysis will provide information on how assignments based on EPAS-enhanced REQUEST will compare to REQUEST assignments in meeting overall monthly Army accession goals. The month unit of time in this analysis refers to the receiving station month (RSM), not the contract month, of a recruit.

The overall Army monthly accessions will be summarized separately under REQUEST and EER classification conditions by simulation replicate using the indices

$$AP_R(l,r)=\frac{\left(\begin{array}{c}\text{overall Army total accession for the } l\text{th RSM during the}\\ r\text{th replication of REQUEST assignments}\end{array}\right)}{\text{overall Army target accession for the } l\text{th RSM}}$$

$$AP_E(l,r)=\frac{\left(\begin{array}{c}\text{overall Army total accession for the } l\text{th RSM during the}\\ r\text{th replication of EPAS enhanced REQUEST assignments}\end{array}\right)}{\text{overall Army target accession for the } l\text{th RSM}}$$

These indices are just the proportion of overall Army target accession met for the *l*th RSM during the *r*th replication

Priority MOS Monthly Accession

The second set of accession analyses will examine how EPAS-enhanced REQUEST and REQUEST recruit assignments compare in meeting monthly accession goals of priority MOS. The monthly accessions of priority MOS will be summarized by replicate using the indices

$$AP_R^P(l,m,r)=\frac{\left(\begin{array}{c}m\text{th priority MOS total accession for the } l\text{th RSM during the}\\ r\text{th replication of REQUEST assignments}\end{array}\right)}{m\text{th priority MOS target accession for the } l\text{th RSM}}$$

$$AP_E^P(l,m,r)=\frac{\left(\begin{array}{c}m\text{th priority MOS total accession for the } l\text{th RSM during the}\\ r\text{th replication of EPAS enhanced REQUEST assignments}\end{array}\right)}{m\text{th priority MOS target accession for the } l\text{th RSM}}$$

The indices $AP_R^P(l,m,r)$ and $AP_E^P(l,m,r)$ represent the proportion of the *m*th priority MOS target accession met for the *l*th RSM during the *r*th replication, respectively, under REQUEST and EER classification conditions.

Priority MOS Fiscal Year Accession

The last set of accession analyses will look at how EPAS-enhancement impacts fiscal year accession goals of priority MOS. This is essentially a repetition of the preceding analysis, but applied to the full fiscal year accession goals of the *m*th priority MOS.

The fiscal year accessions of priority MOS will be summarized by replicate, respectively, under REQUEST and EER conditions using the indices

$$AP_R^{PY}(m,r) = \frac{\begin{pmatrix} m\text{th priority MOS total accession for the fiscal year during the} \\ r\text{th replication of REQUEST assignments} \end{pmatrix}}{m\text{th priority MOS target accession for the fiscal year}}$$

$$AP_E^{PY}(m,r) = \frac{\begin{pmatrix} m\text{th priority MOS total accession for the fiscal year during the} \\ r\text{th replication of EPAS enhanced REQUEST assignments} \end{pmatrix}}{m\text{th priority MOS target accession for the fiscal year}}$$

These indices are the proportion of the *m*th priority MOS target accession met for the fiscal year during the *r*th replication.

Analyses By Evaluation Periods

The following discussion describes the analyses that will be carried out at different evaluation periods. It provides an overview of the simulation experiment at each evaluation period, the questions that will be considered, and a summary of evaluation indices that are relevant for the different types of analyses. Technical issues that are considered to be important in the proper implementation of the analyses are mentioned in the discussion.

Preliminary Monthly Analyses

We will conduct preliminary analyses using recruit cohorts from each of two or three months selected from the first six contract months in the field test. Analysis results will be reported separately for each evaluation month as REQUEST transaction data become available. Only research questions related to job list comparisons and classification efficiency benefits will be considered in these preliminary analyses, which will be based on fixed actual REQUEST lists. Given the monthly nature of the evaluation period, examining accession goals at this stage is not very meaningful as recruits who report during a given receiving station month ordinarily come from more than one contract month.

Job List Analyses

Alternative descriptive analyses comparing REQUEST and EPAS lists will be carried out using recruit cohort from each of the selected months. These analyses are grouped into two parts in the following discussion. The first part deals with the different ways of evaluating the size of intersection between the two lists, while the second part pertains to the analysis of top-*n* priority MOS.

A brief overview of the analysis using the length of intersection index is as follows. The discussion is based on the *YN* index, but will also apply to the *YP* and *QP* indices. The three indices corresponding to different representations of the size of intersection are shown in Table 3, along with "replicate observations" from which they are computed. These expressions were described earlier in detail.

Table 3
Job List Analysis of the Length of Intersection

Analysis Index	Replicate Observations	Subgroup Analysis Factor
Length of Intersection		
$\overline{YN}(r)$	$YN(i,r)$	(Overall)
$\overline{YN}_{CAT}(GRP,r)$	$YN(i,r)$	SEX, TSC, EDUC
Proportion of Intersection		
$\overline{YP}(r)$	$YP(i,r)$	(Overall)
$\overline{YP}_{CAT}(GRP,r)$	$YP(i,r)$	SEX, TSC, EDUC
Quality of Intersection		
$\overline{QP}(r)$	$QP(i,r)$	(Overall)
$\overline{QP}_{CAT}(GRP,r)$	$QP(i,r)$	SEX, TSC, EDUC

Observations $YN(i,r)$ will be computed for the *i*th recruit at the *r*th simulation replicate of a given month. The sample size of *YN* observations will be equal to the number of contracts during the month. (This is naturally fixed over assignment replications r=1,2,...,30.) Each $YN(i,r)$ will represent the number of matching MOS between the recruit's fixed actual REQUEST and EPAS lists at the *r*th replication.

The sample *YN* observations will be analyzed using numerical or graphical descriptive statistics. In addition to the index $\overline{YN}(r)$ this analysis can also include percentiles to summarize the $YN(i,r)$ of all recruits in the month. Computation of these descriptive statistics will be carried out over all 30 independent replications. This analysis will provide information about the typical length of intersection between EPAS and REQUEST lists, along with an associated measure of sampling variation, over monthly recruit assignments.

Descriptive analysis of the length of intersection between REQUEST and EPAS lists will also be carried out by recruit gender, AFQT category, and education level. Statistics summarizing the intersection between the two lists will be compared across levels of each of these factors. These analyses will be helpful in detecting potential differential impact of EPAS enhancement on MOS training opportunities of recruits.

The second set of descriptive analyses will compare the number of priority MOS included at the top-*n* of REQUEST and EER lists. The relevant indices and observations are shown in Table 4. Unlike in the job lists intersection analyses, for the *i*th recruit, separate "observations" will be constructed from each type of list. The matched pairs of observations are given by $\overline{YN}_R^{(n)}(i,r)$ and $\overline{YN}_E^{(n)}(i,r)$. The analysis here will focus on the intra-recruit difference $\left|\overline{YN}_E^{(n)}(i,r) - \overline{YN}_R^{(n)}(i,r)\right|$. This difference is meaningful as the correspondence between recruit

identity and contract date in the database will be retained in the off-line REQUEST and EER simulated assignments. The overall structure of the analysis will be the same as in analyses pertaining to job list intersection.

Table 4
Job List Comparison Analysis of Count of Top-n Priority MOS

Analysis Index	Replicate Observations	Main Analysis Factor (Type of List)	Subgroup Analysis Factor
$\overline{YN}_R^{(n)}(r)$, $\overline{YN}_E^{(n)}(r)$	$YN_R^{(n)}(i,r)$, $YN_E^{(n)}(i,r)$	REQUEST, EPAS-Enhanced REQUEST	(Overall)
$\overline{YN}_{R,CAT}^{(n)}(GRP,r)$, $\overline{YN}_{E,CAT}^{(n)}(GRP,r)$	$YN_R^{(n)}(i,r)$, $YN_E^{(n)}(i,r)$	REQUEST, EPAS-Enhanced REQUEST	SEX, TSC, EDUC

Classification Efficiency

Preliminary analyses of potential classification efficiency benefits of EPAS enhancement of REQUEST will also be examined in the preliminary monthly evaluations. Table 5 identifies the three types of classification efficiency analysis that will be performed. These analyses will be based on predicted performances of recruits in the given month. Two separate predicted performance values will be computed for each recruit in a replication, one each under REQUEST and EER conditions. The primary index in these analyses is the MPP of the recruit cohort in the evaluation month, computed separately under the two assignment conditions, and over assignment replications r=1,2,...,30.

The goal in these analyses is the comparison of overall cohort person-job fit under REQUEST and EER classification conditions, as indicated by their respective mean predicted performances. The formal analysis underlying this comparison may be carried out using an ANOVA framework based on the 30 replicated MPP values $MPP_R(r)$ and $MPP_E(r)$, with the REQUEST and EPAS-enhanced REQUEST conditions as factor levels. The underlying test statistic will account for the variation in MPP across replications under each simulation condition. This between simulation replicate variability will arise through the randomness of MOS training assignments of the same recruit cohort, which is due to the chance factor built in the choice model. For the difference in MPP between the two conditions to be significant, it has to be substantial relative to the chance factor in the choice model.

The analyses will also be carried at the individual MOS level. The mean predicted performance of monthly cohort will be computed separately for each MOS in each replication. This analysis will provide information on how potential classification gains are distributed across MOS. It will emphasize descriptive analysis, identifying MOS with MPP patterns that depart substantially from that in the overall analysis, rather than a formal statistical test of difference in the MPP under the two conditions by MOS.

Table 5
Classification Efficiency Analysis

Analysis Index	Replicate Observations	Main Analysis Factor (Type of List)	Subgroup Analysis Factor
Overall MPP			
$MPP_R(r)$, $MPP_E(r)$	$PP(i,h_R(i,r)), PP(i,h_E(i,r))$	REQUEST, EPAS-Enhanced REQUEST	(Overall)
MOS-Level MPP			
$MPP_R(m,r)$, $MPP_E(m,r)$	$PP(i,h_R(i,r)), PP(i,h_E(i,r))$	REQUEST, EPAS-Enhanced REQUEST	(Analysis by MOS)

Classification Efficiency and Size of Intersection

If the ANOVA analysis of the overall cohort MPP indicate that EPAS enhancement provides classification efficiency benefits, a follow-up analysis on how it is related to the size of the intersection between EPAS and REQUEST list would be meaningful. The results of this analysis may be useful in decisions regarding future refinement of the optimization model underlying EPAS.

This analysis will be based on the difference in recruit predicted performances under the REQUEST and EER classification conditions given by

$$DeltaPP(i,r) = PP(i,h_E(i,r)) - PP(i,h_R(i,r)),$$

and on $SIZE(i,r)$, the size of the intersection between REQUEST and EPAS lists using any of the three representations of the size of intersection. The formal analysis will be based on the regression of $DeltaPP(i,r)$ on $SIZE(i,r)$ as indicated by the model

$$DeltaPP(i,r) = B_0 + B_1 \times SIZE(i,r) + \varepsilon(i,r)$$

In this analysis a positively significant *SIZE* effect will be favorable to EPAS, because a positive value of $DeltaPP(i,r)$ represents a classification gain in terms of predicted performance for the *i*th recruit.

Intermediate Analyses

An intermediate set of analyses will be carried out using the first six months of field test data. All three types of research questions (job list comparison, classification efficiency, and accession) will be examined in these analyses. Unlike in the preliminary monthly analyses, a single result for each analysis will be reported for the entire six-month evaluation period. The intermediate analyses will begin to look at "cumulative effects" of EPAS. Longitudinal patterns in the indices that may develop in time will be taken into account. REQUEST and EER assignments, however, will continue to be based on the (fixed) actual REQUEST list of recruits.

What would be replicated in the intermediate analysis simulation is the whole six-month, rather than monthly, recruit-MOS assignments. The simulation will cycle back to the start of the first month at the end of the sixth month. This is in contrast to the simulation cycle in the preliminary monthly analysis, where recruit-MOS assignments are reset to that at the beginning of the month after assigning the last recruit in the same month. This extension from monthly to six-month simulation of recruit-MOS assignments will allow cumulative effects to be examined in the intermediate analyses.

Extension of Job List and Classification Efficiency Analyses

Job list comparison and classification efficiency analyses will be carried out in the same manner as described in the preliminary analysis, but expanded with the addition of a component representing the contract month factor. Descriptive analysis comparison of REQUEST and EPAS job lists, using the intersection length $YN(i,r)$, will look at possible systematic changes in monthly mean lengths of intersection across replications of six-month recruit assignments. This will provide some insight on any time-related impact of EPAS enhancement on recruit MOS training choices.

Analyses of EPAS classification efficiency benefits will include a model component that will account for potential monthly pattern in MPP. This analysis feature, for example, will be useful in studying the level, over time, of anticipated EPAS classification benefits. Because of the data generation process in the intermediate analyses, monthly indices computed from the same replication will be correlated longitudinally. However, we will continue to obtain independent samples of "longitudinal" observations over replications of six-month recruit assignments.

Accession Analyses

Initial examination of the questions related to monthly accession requirements will be added in the six-month intermediate analyses. We will compare how Army accession goals are met under the REQUEST and EER conditions, at the overall Army and priority MOS levels. These analyses, however, will be constrained as described below.

In general, overall Army accessions will depend more on the size and eligibility of the applicant pool, which will be fixed in the field test, than upon the recruit-MOS classification system. The analyses of overall Army accessions will be restricted in this sense. However, differences between the overall monthly Army accessions under the two simulation conditions are still possible as EPAS rearranges the MOS-class start months in REQUEST list. The analysis of priority MOS accession for the entire evaluation period also will be relatively less constrained, as a differently rank ordered list can substantially impact MOS level fill rates.

Indices required in accession analysis are presented in Table 6. In the overall Army level analysis, the proportions of target accession met at the lth month under REQUEST and EPAS-enhanced REQUEST classification systems, which are given by $AP_R(l,r)$ and $AP_E(l,r)$, will be computed for replications r=1,2,...,30. Note that these indices are naturally defined relative to the receiving station month rather than contract month. However, as in the job list and

classification efficiency analyses, the longitudinal correlation of monthly indices computed from the same replication will be taken into account.

Table 6
Accession Analysis

Analysis Index	Main Analysis Factor (Type of List)	Subgroup Analysis Factor
Overall Monthly Accession		
$AP_R(l,r), AP_E(l,r)$	REQUEST, EPAS-Enhanced REQUEST	(Overall)
Priority MOS Monthly Accession		
$AP_R^P(l,m,r), AP_E^P(l,m,r)$	REQUEST, EPAS-Enhanced REQUEST	(Analysis by MOS)

The overall Army accession analysis will be supplemented by the analyses of monthly accessions of priority MOS. This is important in uncovering a possible negative impact of the EPAS enhancement on accession goals of important MOS, which can occur even if the overall accession analysis indicates equal or better accession rates under the EPAS-enhanced REQUEST condition. The proportions of accessions relative to target goals of the *m*th priority MOS, represented by $AP_R^P(l,m,r)$ and $AP_E^P(l,m,r)$ respectively under REQUEST and EPAS-enhanced conditions, will be computed at each replication. The monthly accession pattern across replications will be summarized numerically and graphically.

Since the priority MOS draw from the same applicant pool, along with the non-priority MOS, accession rates are not independent across MOS. (The exact nature of the dependence pattern will be a characteristic of the classification system. For instance, it will determine the extent to which a gain in accessions by one MOS is a disadvantage to another MOS.) Thus, a suitable analysis of the impact of EPAS enhancement on priority MOS accessions would have to compare the full vector of priority MOS fill rates under REQUEST and EPAS-enhanced REQUEST conditions. Numerical and graphical descriptive statistics will be employed to highlight fill rate vector pattern and identify disadvantaged MOS by EPAS enhancement. Univariate test statistics that will separately compare accession rates by MOS under the two conditions may also be computed, with the "multiple comparison" issue ignored. These univariate test statistics can be utilized less formally as indices for identifying disadvantaged MOS.

Full Fiscal Year Analyses

The final set of analyses will examine the three types of study questions using a full fiscal year evaluation period. These analyses will employ fixed actual REQUEST lists or dynamically generated REQUEST lists, depending on the feasibility of the latter. The dynamic list approach will be indispensable if alternative DEP lengths are to be examined. The simulation will cycle back to the start of the first month after making the MOS assignment for the last recruit at the 12th month in the evaluation period. This extended simulation cycle is expected to provide better information on EPAS cumulative effects, especially if combined with the dynamic REQUEST list generation.

Other than possible difference in the type of REQUEST list, the statistical structure of the indices and their analyses will be similar to that in the intermediate analyses. There will be important issues that require special consideration if the dynamic REQUEST list generation were employed in the full fiscal year simulations. These issues are discussed below.

Job List Comparison

If a dynamic list generation method were implemented, the composition and rank order of MOS-class start dates would be shaped dynamically by the fill rate pattern from earlier recruit assignments, separately under REQUEST and EER simulation conditions. In this case, the distinction between *assignment* and *intermediate* REQUEST lists mentioned earlier would be important. The two types of REQUEST list may diverge in time as recruit-MOS assignments are made during the 12-month evaluation period. (Their difference in time most likely will depend on the length of DEP allowed in the simulation.) This is not a critical issue in the preliminary and intermediate analyses, which are based on the fixed actual REQUEST list of recruits, but needs to be considered in a full fiscal year analysis that is based on the dynamic REQUEST list approach.

The "*YN*" and "*YP*" indices of the length of intersection may be constructed, optionally, using the *assignment* REQUEST list. The analyses based on these indices will compare the MOS training opportunities that recruits will face under the two classification conditions. Note that this is different from the analysis of the "*YN*" and "*YP*" indices that are constructed using the underlying intermediate REQUEST list in the EER classification condition, which deals more with understanding the extent to which the EPAS model optimizes REQUEST. Job list analyses regarding top-*n* priority MOS will continue to use the *assignment* version of REQUEST, as the relevant underlying issue pertains to rank ordered MOS training opportunities that recruits will face, and not the interim rank ordered training opportunities in the *intermediate* REQUEST list.

Classification Efficiency and Accession Analysis

The implementation of the dynamic REQUEST list generation will not impact the nature of analyses for comparing classification efficiency and accession rates under REQUEST and EER conditions. The classification efficiency indices will be computed as in the six-month intermediate analyses. The longitudinal dependence among monthly values of these indices, however, will remain as described before.

A key improvement of the dynamic list over the fixed list approach is a potentially more accurate measure of EPAS cumulative benefits. As mentioned earlier, using dynamically updated fill rates in determining the composition and order of MOS choices in the EER list will likely to lead training assignments that, in turn, will yield a fill rate pattern that is person-job fit efficient for subsequent recruit assignments.

Based on the preceding observation, EPAS cumulative efficiency benefits observed in intermediate analyses using the fixed REQUEST list may be viewed as conservative estimates or baseline values. Unfortunately, this also implies that any adverse effect of EPAS on accession

goals observed in analyses based on a fixed actual REQUEST list also will be baseline estimates. The degree to which cumulative effects on accession goals can be accurately evaluated will be determined by the fidelity of the simulated model that will represent the dynamic factors in the REQUEST system.

An additional analysis that may be carried out in the full fiscal year evaluation is the fiscal year accession goals of priority MOS. The relevant analysis index and replicate "observations" are shown in Table 7. We will not be concerned about a longitudinal correlation in this analysis, which will only deal with the fiscal year accession rates. However, the full vector of priority MOS accession rates will continue to be correlated as the MOS compete from the same pool of applicants. Thus, comparison between accession rates under the REQUEST and EER conditions will be carried out in a multivariate fashion.

Table 7
Expanded Accession Analysis

Analysis Index	**Replicate Observations**	**Main Analysis Factor**	**Subgroup**
Overall Monthly Accession			
$AP_R(l),\ AP_E(l)$	$AP_R(l,r), AP_E(l,r)$	REQUEST, EPAS-Enhanced REQUEST Lists	(Overall)
Priority MOS Monthly Accession			
$AP_R^P(l,m),\ AP_E^P(l,m)$	$AP_R^P(l,m,r), AP_E^P(l,m,r)$	REQUEST, EPAS-Enhanced REQUEST Lists	(MOS Level)
Priority MOS Fiscal Year Accession			
$AP_R^{PY}(m),\ AP_E^{PY}(m)$	$AP_R^{PY}(m,r),\ AP_E^{PY}(m,r)$	REQUEST, EPAS-Enhanced REQUEST Lists	(MOS Level)

Appendix A

Overview of Recruit MOS Assignment Decision Model Approach

In this write-up we give a technical overview of our approach to modeling recruit job choice behavior. The technique that we present here is part of what is commonly known in the econometrics literature as discrete choice modeling.[11] This will be described using an Army recruiting framework. Our discussion will focus on the rationale of the general approach, using a simplified version of the model. Complete specification of the choice model will be finalized using actual REQUEST transaction data. We also outline how the choice model will be utilized for simulating training choices of recruits in the off-line MOS assignments. The model obtained at the end is not intended to represent an individual recruit's choice decision process. The objective is to statistically model MOS choice and recruit profile pattern in the population for the purpose of simulating recruit choice in the EPAS field test.

Consider a hypothetical transaction at a Military Enlistment Processing Site (MEPS) during which a new Army recruit is presented with a list of training choices. The index i will be used to label recruits and index j to label the choices in the list presented to the ith recruit. We simplify our discussion by assuming that a fixed set of m distinct MOS training choices are presented to all recruits. In actual MEPS transactions, the same MOS may appear twice or more with different training start dates.

We now characterize the enlistment decision problem of the ith recruit who is presented with m alternative MOS training choices. From the perspective of this particular recruit, the choice may be determined by the utilities that he or she attaches to the alternative MOS. For recruit choice modeling purposes, utility is associated to a general notion of "attraction" that may or may not be economic in nature. Using this relaxed notion of utility, it may be assumed that the recruit will behave rationally by picking the training option in the list that he or she "likes" best. More formally, let $\{U_{i1}, U_{i2}, \ldots, U_{im}\}$ denote the utility set that the ith recruit associates to these m choices. If $U_{c_i} = \max_j \{U_{ij} \mid j = 1,2,\ldots,m\}$, then the recruit will choose the c_ith training option in the list.

The individual-centric choice behavior described above is fully deterministic. Given a set of MOS training choices (with specified choice attributes such as start dates, bonuses and incentives), we expect the same recruit to choose the same training option. However, we are not interested in the behavior of an individual recruit per se, but in the recruit profile-MOS choice pattern revealed in the MEPS transaction data. In other words, we want to be able to model recruit choice behavior from the perspective of the researcher. To accomplish this, we let

$$U_{ij} = V_{ij} + E_{ij},$$

[11] McFadden, D. (1974). Conditional Logit Analysis of Qualitative Choice Behavior. In P. Zarembka (Ed.). *Frontiers in Econometrics*. New York: Academic Press.

represent the utility of the *i*th recruit for the *j*th training option. The first term on the right hand side is of the form $V_{ij} = f(x_i, z_{ij})$. The value of $f(x_i, z_{ij})$ represents the common level of attractiveness of all recruits in the population with attribute vector x_i for the *j*th training option with attribute vector z_{ij}. The second term, E_{ij}, represents idiosyncrasies of individual "tastes" that are unobservable from the researcher's point of view. It is from the second component that the "random" part in our choice model is obtained. The E_{ij} s are treated as realizations from some probability distribution.

In our approach we will take *f* to be a linear function of recruit and choice attributes. We will write

$$V_{ij} = a^T x_i + b^T z_{ij}$$

where *a* and *b* are coefficient vectors associated, respectively, to recruit attributes and training choice attributes. The coefficients will reflect the importance of the associated recruit or choice attribute in the determination of utility U_{ij}. Under simple distribution assumptions for E_{ij}, the probability p_{iq} that the *i*th recruit will select the *q*th training choice, from a researcher's point of view, is given by

$$p_{iq} = \frac{\exp(V_{iq})}{\sum_{j=1}^{m} \exp(V_{ij})},$$

for q=1,2,...,m. This is also known as the multinomial logit discrete choice model.

The parameter vectors of coefficients, ***a*** and ***b***, of specified recruit and choice attribute sets may be estimated from REQUEST transaction data given the above probability model representation.

The parameter estimates then will be used to compute probabilities $\{p_{ij} \mid j = 1,2,\ldots,m\}$ for the *i*th individual in the field test. The probability p_{ij} will represent the likelihood of the *i*th recruit "choosing" the *j*th training option in his or her REQUEST list during the off-line simulations. In this probabilistic representation of choice behavior, the *i*th recruit does not necessarily select the choice corresponding to the largest probability. (The probabilities are a researcher's representation of the recruit's choice behavior pattern, and are not to be equated to the individual recruit's utilities.) Instead, the probabilities will represent the odds of the alternative training opportunities in the list, any of which can be randomly selected by the recruit at the *r*th simulation replication. These probabilities will reflect the relative proportions of selection over infinite replications of recruit assignments.

We ~~briefly~~ ~~illustrate~~ a ~~randomized~~ recruit choice selection process that will be considered in the simulations. To simplify the example, we suppose that a recruit is presented with only m=5

training options. Based on the estimates of the choice model parameters, suppose we computed the probabilities that the recruit will select each of the five training choices to be .10, .10, .30, .35, and .15, respectively. A randomization rule that can be employed during the *r*th replication is as follows. Generate a uniform pseudo random number W between 0 and 1. Then assign the recruit to the *j*th alternative training opportunity in the REQUEST list according to the table

Value of W	$0<W\leq..10$	$.10<W\leq.20$	$.20<W\leq.50$	$.50<W\leq.85$	$.85<W\leq.1.00$
Training Choice	j=1	j=2	j=3	J=4	j=5

This method will yield random assignments for the recruit across replications with expected proportions given by .10, .10, .30, .35, and .15.

Appendix B

Quality of the Intersection Between the REQUEST and EPAS Lists

The indices based on simple counts do not take into account the rank order location of REQUEST MOS-class start dates in the EPAS list. Instead, all matching MOS-class start dates contribute equally to the values of the indices. Consider, for example, two recruits (i=1,2) with actual counts $YN(1,r)$ and $YN(2,r)$ of matching MOS-class dates in their respective REQUEST and EPAS lists. Now $YN(1,r)$ could be equal to $YN(2,r)$ even if all of the matching MOS-class dates for the first recruit appear at the top-half of his EPAS list, while those for the second recruit appear at the bottom-half of his EPAS list. Thus, the similarities between REQUEST and EPAS lists of these two recruits implicitly are equal using the index *YN*. In turn, this would seem to suggest that the two recruits contribute equally to EPAS enhancement of REQUEST. This unintended interpretation clearly is not desirable.

We address the preceding limitation by specifying an index that takes into account (1) the rank order location of matching MOS-class dates in the EPAS list and (2) the changes in their rank order positions from the original REQUEST list to the EPAS-enhanced REQUEST list. This measure of similarity will be based on a "quality score" Q which we construct for each recruit as follows.

Start by using $EER(m,i,r)$ to denote the EPAS-enhanced REQUEST rank order position of the mth MOS-class date alternative in the REQUEST list of the ith recruit. Then

$$DR(m,i,r) = m - EER(m,i,r)$$

is the change in the rank order position of the mth MOS-class date in the REQUEST list after EPAS reordering of the REQUEST list. We also record the EPAS list rank order location of each alternative MOS-class date in REQUEST by letting

$$ER(m,i,r) = \begin{pmatrix} \text{rank order of the EPAS MOS - class month that matches} \\ \text{the } m\text{th REQUEST MOS - class date} \end{pmatrix},$$

if the mth MOS-class date in the REQUEST list appears in the EPAS list; otherwise, we let $ER(m,i,r) = -1$ to indicate that the mth MOS-class date is not in the EPAS list.

Using the preceding expressions, the contribution of the mth MOS-class date alternative in REQUEST list may be quantified meaningfully by

$$QM(m,i,r)=\begin{cases}1+\left[1-\dfrac{ER(m,i,r)}{LE(i,r)}\right]\dfrac{DR(m,i,r)}{LR(i,r)} & , \quad ER(m,i,r)\geq 0 \text{ and } DR(m,i,r)>0\\ 1 & , \quad ER(m,i,r)\geq 0 \text{ and } DR(m,i,r)\leq 0\\ 0 & , \quad ER(m,i,r)=-1\end{cases}$$

where $LE(i,r)$ is equal to the length of the EPAS list of the ith recruit. An intersection quality value computed for the ith recruit based on $QM(m,i,r)$ is given by

$$QP(i,r)=[1/LR(i,r)]\sum_{m=1}^{LR(i,r)}QM(m,i,r)$$

We make the following initial observations on the proposed quality value $QP(i,r)$. First, the difference $[1-ER(m,i,r)/LE(i,r)]$ represents the EPAS percentile rank of the mth MOS. (Percentile rank values near 1 correspond to MOS-class start dates at the top of the EPAS list.) The fraction $DR(m,i,r)/LR(i,r)$ represents the REQUEST percentile rank difference associated with the mth MOS-class start date due to EPAS reordering of the REQUEST list. Thus, using the first line on the right-hand side of the expression for $QM(m,i,r)$ above, REQUEST MOS-class dates that match MOS-class months at the top of the EPAS list will have high contributions to $QP(i,r)$. Moreover, these MOS-class dates will have higher contributions to the intersection quality value if their rank orders go up substantially after EPAS reordering.

Continuing, we look at the second line in the expression for $QM(m,i,r)$. This will correspond to the quality value contribution of MOS-class dates in the REQUEST list with matching EPAS-class months, but whose rank order dropped after EPAS enhancement. $QM(m,i,r)$ does not penalize these MOS-class dates. They will continue to contribute to the intersection quality score, but only by unity (as in the simple count indices). The drop in rank order can only occur if there is at least one MOS-class date that should be ranked higher.

It can be verified that $YP(i,r)\leq QP(i,r)<2YP(i,r)$, where $YP(i,r)$ is the proportion of common MOS-class dates relative to the length of the REQUEST list, as defined earlier. The lower limit equality occurs if all MOS-class dates in the REQUEST list with matching EPAS class-months appear at the top-$YN(i,r)$ of the list in proper EPAS-order. Under this condition EPAS does not enhance the REQUEST list as it is already in the desired EPAS order, and the quality of intersection is nothing but the size of intersection measured in proportion (i.e., $YP(i,r)$). On the other hand, $QP(i,r)$ is near the upper bound $2YP(i,r)$ when the REQUEST MOS-class dates match the top-$YN(i,r)$ MOS-class months in the EPAS list, but appear at the bottom-$YN(i,r)$ of the REQUEST list in reversed EPAS- order.

The intersection quality value $QP(i,r)$ is an improvement over $YP(i,r)$, the proportion index based on simple count of matching MOS training opportunities in the REQUEST and

EPAS lists of recruits. A meaningful measure of the contribution of the *i*th recruit to the overall EPAS enhancement of REQUEST is given by $QP(i,r) - YP(i,r)$. This difference expression separates the enhancement of REQUEST due to EPAS reordering from the simple count of matching MOS training class dates. The overall or subgroup forms of the difference $\overline{QP} - \overline{YP}$ would be useful in characterizing the potential EPAS enhancement.